TAXONOMIC REVISIONS IN THE FAMILY HALORAGACEAE

I. THE GENERA HALORAGIS, HALORAGODENDRON, GLISCHROCARYON, MEZIELLA AND GONOCARPUS

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I. INTRODUCTION

This work forms the first part of a monograph of the predominantly southern hemisphere family Haloragaceae. It is based on all available herbarium material, supplemented by observations of many species in the field.

The only other monograph of Haloragaceae since the Prodromus of A. P. de Candolle (1828) is that of Schindler (1904, 1905). This treatment, although nearly 65 years old when the present study began, has formed the basis for considerations of family, generic and species relationships and delimitations for most of this century. Schindler's treatment suffered largely from the inadequacy and paucity of the only material available to him, namely that in continental European herbaria. In many cases only one or two collections were available for each species; rarely as many as ten. Despite, or possibly because of this, Schindler adopted a very narrow species concept (although his genera were relatively wide in circumscription) and described many new species and taxa of lower rank on account of a single specimen or very few collections. Not surprisingly, several of these new taxa have subsequently been found difficult to recognise.

In the past fifty years collections of Haloragaceae, particularly in Australian and New Zealand herbaria, have greatly increased by comparison with the amount of material available to Schindler. Attempts to name these collections have not only drawn attention to the unsatisfactory nature of many of Schindler's taxa, but have also resulted in the description of several species unknown to him. In some cases the authors of these new species tried to place them within Schindler's framework for the family, but more often they described the species in apparent ignorance of his work.

This account consists of a discussion of previous work on the family, a survey of the morphological and biosystematic criteria found to be of use in taxonomic treatments of the group, and the first part of a proposed taxonomic revision of the family. This latter covers all genera included in Schindler's tribe Halorrhageae, with the exception of *Laurembergia* and *Proserpinaca*.

MATERIALS AND METHODS

The study of herbarium material was carried out at the State Herbarium of South Australia (AD) and the Auckland Institute and Museum (AK); anatomical studies were made at the Botany Department, University of Adelaide.

Herbarium and Laboratory

Collections from the following herbaria (abbreviated according to Lanjouw & Stafleu, 1964; Stafleu, 1966) were examined and annotated: A, AD, ADW, AK, BISH, BM, BRI, CANB, CANTY, CANU, CBG, CGE, CHR, G, GH, GOET, HBG, HO, K, LE, M, MEL, NE, NSW, NT, NY, OTA, P, PERTH, PNH, PR, S, SYD, TI, U, UPS, US, UWA, W, WELT, WELTU. A large number of specimens from the private herbarium of Mr A. C. Beauglehole of Portland, Victoria, were also examined and these are cited as BEAUG. A few collections from other herbaria not listed by Lanjouw and Stafleu were also seen; the names of these herbaria are written out in full in the relevant place. Material of *Laurembergia* and *Proserpinaca* species was obtained on loan from herb. P and US for comparative purposes. As these genera were not revised at the species level, the collections were not annotated.

The types of most validly published names referred to the revised genera have been examined and this is indicated by an exclamation mark (!) after the abbreviation for the relevant herbarium. Where the type was not available, this is indicated by n.v. (*non vidi*) in the same position. Photographs of type material of species described by Labillardiere were sent from FI instead of the specimens and these were found sufficient for the purpose of lecto-typification. A photograph of the type of *H. acanthocarpa* was received from P. In the text these types are annotated (photo.!).

All collections examined in this study (except some lacking adequate locality data) are cited after the relevant taxon, alphabetically by author under the state or country of collection. Information about the specimen is given in the following order: collector, collector's number, date, locality, herbarium, herbarium number, state of development, special status (e.g. types, voucher specimens). The herbarium sheet number is only included if no collector's number is available. Where lectotypification was necessary, the reasons for the choice made are given at the end of the treatment of the relevant taxon.

Unless it is stated otherwise, the descriptions of all taxa are made from herbarium specimens. Measurements of flower parts are taken either from F.A.A.-preserved material, or from flowers of dried herbarium specimens brought to the boil in fresh water. It was found that the boiling treatment restored the flowers to approximately their size and shape in life or in liquid-preserved material. In the case of species with tightly conduplicately folded petals (e.g. *Haloragis, Gonocarpus*), the measurement of petal width was taken as that apparent without unfolding, i.e. the distance from the keel to one margin, and is given as "width (keel to margin)". In general, usage of terms follows B. D. Jackson (1928) and Stearn (1966). The distribution of each taxon studied is briefly summarised after its description, and the locations of the specimens examined are plotted on a series of maps.

All available information on soils, habitat preference, pollination, rainfall, weediness, flowering and fruiting periods, etc, is included under the heading Ecology after each species. Usually this information is taken from collectors' notes on the labels of herbarium sheets, to which reference is made, supplemented in some cases by reports from the literature and personal field observations.

Floral vascular anatomy

The pattern of vascular strands in the flowers of all genera (except *Meziella*) and a large number of species of Haloragaceae has been studied using serial paraffin sectioning techniques. For the most part material preserved in formalin - acetic acid - ethyl alcohol (F.A.A.) was used. It was dehydrated using a tert-butyl alcohol series, embedded in paraffin, sectioned at 10-15μ and stained in safranin - fast green, all according to the methods of Johansen (1940). Where it was necessary to use herbarium material, the flowers were softened according to the methods of J. L. Cunningham (1969), before proceeding as above. All sections were mounted in XAM and drawn using a Leitz camera lucida, at the magnifications shown. The slides will be deposited in the State Herbarium of South Australia (AD).

Wood anatomy

For the study of wood ray structure in the stems and roots of species of *Haloragis, Haloragodendron, Glischrocaryon* and *Gonocarpus,* the wood samples used were usually fresh material preserved and stored in F.A.A., although in a few cases, herbarium material, soaked in F.A.A. for a few days, was used and found satisfactory. Transverse, radial longitudinal and tangential longitudinal sections were cut at 10-30μ on a sledge microtome, stained in safranin and mounted in XAM. The slides will be deposited in AD.

Field

Plants of most of the Australian and New Zealand species studied were observed in the field and collected during numerous field trips encompassing all Australian States, the Northern Territory and the Australian Capital Territory, and both the North and South Islands of New Zealand. Collections were made of all species of *Glischrocaryon,* three of the five species of *Haloragodendron,* 13 species of *Haloragis,* 14 species of *Gonocarpus*, and several of *Myriophyllum.*

A special field study of the variation in the fruit morphology of *Haloragis acutangula* was made throughout the South Australian range of that species, resulting in a clearer understanding of the taxonomic standing of *H. semiangulata* and *H. ciliata,* which had been described previously, and in an extension of the known range of *H. acutangula.*

The first set of collections made during this study is housed in AD (Australian collections) and AK (New Zealand collections).

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This study is based, in part, on a Ph.D. thesis submitted to the University of Adelaide in January 1972. Since my appointment to the position of Botanist at the Auckland Institute and Museum in April 1972, the work has been amended and expanded to include nearly twice the number of species previously treated, principally involving the genus *Gonocarpus*.

I am indebted to the Directors and Curators of the herbaria who made available loans of herbarium material and photographs of type material for study, and to Dr N. T. Burbidge, Mr B. V. Sneddon and Dr F. A. Sampson for providing liquid preserved material for anatomical studies. I am also grateful for the efforts of many collectors, particularly Mr B. Copley and Mr A. C. Beauglehole, who devoted much time and effort to increasing the number and diversity of collections available. Assistance with field studies was received from those collectors, from Mr J. R. Maconochie, Mrs T. Parsons, my wife, and from many other people. The advice of Mr P. H. Smith and Mr R. D. Seppelt, on technical matters connected with the anatomical studies, is gratefully acknowledged.

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II. HISTORY OF TAXONOMIC TREATMENTS OF HALORAGACEAE

Although the family Haloragaceae R. Br. dates from 1814, all except three of the genera now recognised as comprising the family had been described at least 30 years earlier. The history of the family involved a great deal of inter-family generic shuffling, which, by the mid-nineteenth century resulted in a heterogeneous assemblage of basically aquatic or semi-aquatic plants for which no other place in the "system" could be found. From that time to the present day the tendency has been to remove various anomalous genera to form several small mono-generic families. Some of these are considered to be fairly closely related to Haloragaceae, while others show little or no true affinity.

Species of *Myriophyllum, Prosperpinaca* (based on *Trixis* Mitchell, 1748), *Callitriche, Hippuris* and *Trapa* were described in Linnaeus' Species Plantarum (1753) and the generic names were validated the following year. As a result of the artificiality of the scheme of classification, no relationship between these genera was recognised. In the Mantissa (Nov. 1767) two further genera later included in Haloragaceae, namely *Gunnera* and *Serpicula,* were described. *Laurembergia* had been described two months earlier by Bergius (Sept. 1767).

In the first attempt at a natural system, Adanson (1763) placed the Haloragacean genera known at that time into three distinct families. *Trapa* was included in the family Onagres while *Callitriche* and *Myriophyllum* were placed in the family Ara near *Ceratophyllum. Trixis,* based on the genus of J. Mitchell (1748), was included in the family Aristoloches near *Vallisneria.*

Haloragis was described by J. R. & G. Forster in 1775, and *Cercodia* by Murray in 1780. These two genera were lumped under the later name by A.-L. de Jussieu in 1789. This genus fell into section I ("genera inter Ficoideas & Onagras media") of the family ('Ordo') Onagrae, while *Serpicula* was referred to section II of the same family. Although recognising that *Laurembergia* and *Serpicula* were nomenclaturally synonymous, de Jussieu preferred the later name *Serpicula* to the earlier one. *Cercodia* and *Serpicula* were the only genera placed in the division Dicotyledones. In the division Monocotyledones, *Trapa* and *Proserpinaca* were placed in the family Hydrocharides with other herbaceous aquatics, although some affinity with the family Onagres was suggested for *Trapa.* The remaining genera (*Hippuris, Myriophyllum* and *Callitriche*) were assigned to the family Naiades in the intermediate division Acotyledones. *Gonocarpus* was placed in "plantae incertae sedis", while *Gunnera* was referred to "genera Urticis affina".

The same author, in 1805, substituted the name Onagrariae for the family Onagrae, and added to it *Trapa,* placing it in the same section as *Serpicula.* In this he followed Ventenat (1799). *Proserpinaca* was also removed from the Monocotyledones, and placed next to *Cercodia* in Onagrariae. In this latter paper de Jussieu also removed *Myriophyllum* from the Naiades to Onagrariae, in a position close to *Cercodia,* and suggested a similar affinity for *Callitriche* and *Hippuris.* In an addendum to de Jussieu's paper, Koenig (1805) pointed out the close relationship of *Gonocarpus* (the name of which he changed to *Goniocarpus* because of "too great a similarity subsisting between *Gonocarpus* of Thunberg and *Conocarpus*") to *Cercodia.*

Richard (1808) proposed the name Hygrobiae for the group of genera *Hippuris, Proserpinaca, Haloragis* and *Myriophyllum.* This name was taken up by Cambessedes (1830) ['Hygrobieae'] in preference to R. Brown's (1814) name (Halorageae) and de Jussieu's (1817) name (Cercodianae) for the family, and it was similarly used by Kunth (1838). Spach (1835) reduced Richard's name to the rank of Tribe under Halorageae. He changed the composition of the group by removing *Hippuris* to Tribe Hippurideae and adding *Trapa, Meionectes, Cercodia* and *Serpicula* to Hygrobieae. The third tribe of the family was the monogeneric Callitriche.

Spach's treatment of Halorageae differs markedly from that of Reichenbach (1828) in which three subdivisions were recognised: Hygrobiae ['Hydrobiae'] consisting of *Myriophyllum, Proserpinaca* and *Trapa*; Cercodeae (*Hippuris, Serpicula, Goniocarpus, Meionectes, Haloragis* and *Cercodia* and Datisceae (*Tetrameles* and *Datisca*).

In 1814, Robert Brown discussed the difficulty of defining a family (Onagrariae) to include such diverse elements as *Myriophyllum* and *Fuchsia.* He proposed a new family, Halorageae, allied to Onagrariae, and comprising the genera *Haloragis, Serpicula, Proserpinaca, Hippuris, Callitriche* and the newly discovered *Meionectes. Gonocarpus* was reduced to a synonym of *Haloragis.* Brown was followed by S. F. Gray (1821) and Dumortier (1829) ['Haloragideae'].

A. P. de Candolle (1828) accepted the family Halorageae more or less as defined by Robert Brown and divided it into three tribes. Cercodianeae contained *Serpicula, Goniocarpus, Haloragis, Cercodia, Proserpinaca* and *Myriophyllum,* while Callitrichineae and Hippuridineae were both monogeneric. The family was placed between Onagrariae and Ceratophylleae. In 1868, A. de Candolle added a fourth tribe Gunnereae, following Endlicher (1840), Bentham & Hooker (1865), and Blume (1856), *Gunnera* having previously been placed in Artocarpaceae by Bartling (1830), in Urticaceae by Gaudichaud (1830) and Endlicher (1837), and in Araliaceae by Lindley (1846). The de Candolle arrangement of the family was widely accepted in continental Europe, and was adopted, in essence, by many subsequent writers, e.g. Don (1832), Wight & Arnott (1834) and Meisner (1838).

Glischrocaryon, the last of the major genera included in modern treatments of Haloragaceae, was described by Endlicher in 1838 and assigned to the family Santalaceae. The same genus was described by Lindley (1840) as *Loudonia* in the family Halorageae. The two names were united under the latter by Endlicher (1840), and this precedent was followed by all subsequent authors. The priority of *Glischrocaryon* was discussed by Orchard (1970).

Lindley (1846) changed the spelling of R. Brown's name for the family to Haloragaceae, and recognised two tribes. Halorageae consisted of *Hippuris, Myriophyllum, Serpicula, Proserpinaca, Meionectes, Haloragis* and *Loudonia*; Trapeae contained only *Trapa.*

The content and postulated relationships of the Haloragaceae in the mid-19th century is summarised by Bentham & Hooker (1865). The family consisted then of nine genera, *Loudonia, Haloragis, Meionectes, Serpicula, Proserpinaca, Hippuris, Gunnera, Myriophyllum* and *Callitriche. Gonocarpus* and *Cercodia* were considered synonyms of *Haloragis, Glischrocaryon* was subjugated to *Loudonia, Laurembergia* to *Serpicula,* and *Trixis* to *Proserpinaca. Trapa* was referred to Onagraceae. This family was considered to be the most closely related to Haloragaceae.

Bentham (1864) had divided the Australian Haloragaceae into two groups, "True Halorageae" (*Loudonia, Haloragis, Meionectes* and *Myriophyllum*) and "Anomalous genera of a very reduced type allied to Halorageae, but often referred to Monochlamydeae" (*Gunnera, Ceratophyllum* and *Callitriche*). The inclusion of *Ceratophyllum* is not surprising as most authors, from Linnaeus onward, had considered this genus related to Haloragaceae, in particular to *Myriophyllum* and *Hippuris,* both in its habit and in the reduction of the flowers. In Bentham & Hooker's *Genera Plantarum* (1865), *Ceratophyllum* was excluded from Haloragaceae, as it has been by all subsequent authors.

A. Brown (1864) recognised three subfamilies in 'Halorrhagidaceae', namely Hippuridoideae, Callitrichoideae and Myriophylloideae. The family was placed in the order Myrtiflorae near Onagraceae, and Gunneraceae was tentatively removed to Umbelliflorae, near Araliaceae.

Baillon (1877) retained the Halorageae in his family Onagrariaceae, as one of seven "series". Only five genera were retained in Baillon's concept of Halorageae: *Haloragis, Loudonia, Myriophyllum, Serpicula* and *Proserpinaca. Trapa, Gunnera* and *Hippuris* each formed another mono-generic series in the same family. *Callitriche* formed its own series in the family Euphorbiaceae.

Petersen, in Engler & Prantl (1893), excluded *Callitriche* from Haloragaceae, but otherwise recognised the same genera as Bentham & Hooker. Three subfamilies (? Tribes), Halorrhageae, Gunnerae and Hippurideae, were distinguished, the last two being monogeneric.

Schindler (1904), in a preliminary paper to his monograph of the family Haloragaceae, listed the differences between *Hippuris* and the other genera (excluding *Callitriche*) making up Haloragaceae. He concluded that *Hippuris* should be placed in a separate family Hippuridaceae related to the Santalaceae, and in this separation (but not in the placement) he has been followed by most later workers. In his monograph (1905), Schindler divided the family into two subfamilies, Halorrhagoideae and the monogeneric Gunneroideae. The former was further subdivided into two tribes: Halorrhageae consisting of *Loudonia, Laurembergia* (syn. *Serpicula*), *Proserpinaca, Halorrhagis* (including *Meionectes)* and *Meziella* (a monotypic, segregate genus from *Halorrhagis*), and Myriophylleae containing only *Myriophyllum.* He considered the family to be most closely related to Onagraceae, although some affinity to Umbelliflorae, especially Cornaceae, was recognised. Hippuridaceae and Callitrichaceae were regarded as unrelated to Haloragaceae by Schindler. *Trapa* was assigned to Onagraceae, *Ceratophyllum* to its own family. Schindler's placement of the genera and families has been followed by many authors, including Hegi (1925, 1931). Hallier (1912) included *Hippuris* and *Gunnera* in the family Haloragaceae, which he placed in the Ranales, deriving it from a group of families including Nymphaeaceae, Ceratophyllaceae,

Circaeastraceae and Podostemaceae. From Haloragaceae he derived Theligonaceae. *Callitriche* was excluded being placed in a separate family, with a suggestion that its derivation could have been from Linaceae (Guttales) by reduction. *Trapa* was included in Onagraceae (Polygalines).

Rendle (1925) apparently followed Schindler in including *Gunnera* in Haloragaceae and excluding *Hippuris, Callitriche* and *Trapa*. The affinity of Haloragaceae was considered to be with Onagraceae to which family *Trapa* was referred. *Hippuris* formed its own family, of unknown affinity, but included with Haloragaceae and Onagraceae in the order Myrtiflorae. Rendle followed Lindley, Eichler (1878) and Baillon in placing Callitrichaceae near Euphorbiaceae (Tricocceae).

The system of Lawrence (1951) very closely matched that of Rendle. Haloragaceae were derived from Onagraceae, while Hippuridaceae, although placed close to Haloragaceae, were not considered to be related. Callitrichaceae was positioned near Euphorbiaceae. Lawrence followed Diels (1936) in placing *Trapa* in its own family, Hydrocaryaceae, and derived it from Onagraceae by reduction.

Wettstein (1935) retained *Trapa* in Onagraceae, but recognised Gunneraceae and Hippuridaceae. These three families were placed with Haloragaceae in Myrtales. Callitrichaceae were considered to be close to Euphorbiaceae, although an affinity with the Tubiflorae was not ruled out. Onagraceae and Lythraceae were thought to be the families most closely related to Haloragaceae, but the inclusion of this family in Myrtales was questioned. Similarly, the affinities of Gunneraceae and Hippuridaceae, except to Haloragaceae, were considered doubtful.

Pulle (1952) recognised the families Trapaceae and Gunneraceae, but placed them with Haloragaceae and Theligonaceae near Onagraceae at the end of Myrtales. The order adopted was Onagraceae-Trapaceae - Haloragaceae - Gunneraceae - Theligonaceae. *Callitriche* and *Hippuris* were each the basis of monogeneric orders derived from the Solanales.

Hutchinson (1959, 1969) recognised the families Trapaceae and Callitrichaceae, but included *Gunnera* and *Hippuris* in Haloragaceae. All three families were placed near Onagraceae in the Lythrales in 1959 but in the Onagrales in 1969.

Melchior (1964) followed Schindler in the internal subdivisions of the family Haloragaceae, which were placed in the suborder Myrtineae of Myrtales near Onagraceae, Oliniaceae and Theligonaceae. Hippuridaceae were referred to their own suborder, adjacent to the above families. Trapaceae were assigned a position near Lythraceae, after Miki (1959). Callitrichaceae fell between Verbenaceae and Labiatae, this position for the family reflecting embryological findings by Joergensen (1923) and Soueges (1952).

Shaw (1966) excluded *Gunnera, Hippuris* and *Callitriche* from Haloragaceae, for which he postulated a relationship with Datiscaceae (c.f. Reichenbach, 1828) at the same time suggesting that any connection with Gunneraceae was superficial. The latter family was considered to be related to Urticaceae. Callitrichaceae were assigned a doubtful position near Scrophulariaceae, Verbenaceae and Labiatae, while the affinities of Hippuridaceae were considered to be even more doubtful, "prob. connected with Haloragidac., Elatinac., Lythrac., Primulac., etc."

Thorne (1968) placed the Haloragaceae (subfamilies Haloragidoideae and Gunneroideae) and Hippuridaceae in their own suborder Haloragidineae of the Cornales. Here they came between the suborder Cornineae, containing Cornaceae and satellite families, and suborder Araliineae, containing Araliaceae and Apiaceae (as subfamilies of Araliaceae). *Callitriche* was far removed (near Lamiaceae in Lamiales), as was *Trapa* (in Myrtales, near Crypteroniaceae, Combretaceae, Punicaceae, etc.).

Cronquist (1968) agreed with Shaw in placing Callitrichaceae near Labiatae and Verbenaceae. He differed however, in linking the families Haloragaceae, Gunneraceae, Hippuridaceae and Theligonaceae in the order Haloragales, derived parallel to the Myrtales from Rosales. *Trapa* (Trapaceae, Myrtales) was considered to be unrelated to, but convergent with the Halorages.

The relationships envisaged by Takhtajan (1969) are almost identical to those of Cronquist, differing mainly in the derivation of Haloragales (Hippuridales) and Myrtales from Saxifragales instead of Rosales. *Trapa* and *Callitriche* assumed the same places as in Cronquist's system, but Theligonaceae were referred to an order of their own, related possibly to Caryophyllales. Ehrendorfer (1971) adopted a system which agrees closely with those of Takhtajan and Cronquist.

Thorne (1973) modified his system slightly, in recognising the family Gunneraceae as "equivalent to Haloragaceae and Hippuridaceae", but included all three in Suborder Halorагineae. Haloragaceae were thought to have closest relationships with Cornaceae, and to a lesser extent, Rhizophoraceae, following Orchard (1972).

Davidson (1973), in an exhaustive account of the family Datiscaceae, could find little evidence for the relationship of this family to Haloragaceae, as proposed by Shaw (1966).

In retrospect, the taxonomic history of Haloragaceae has been a process of gradual recognition of relationships between originally widely separated taxa which by the mid-nineteenth century had resulted in an agglomeration of genera, some related, some placed together for convenience. Since then, as more evidence became available, the anomalous genera have been removed, often to form monotypic families.

Most modern surveys of angiosperm relationships place Haloragaceae in or near the order Myrtales, often close to Onagraceae, although some workers favour Cornaceae as the most closely related family. *Gunnera, Callitriche, Hippuris* and *Trapa* are now usually excluded from Haloragaceae and form monogeneric families of their own. Of these Gunneraceae and Hippuridaceae are often placed close to Haloragaceae, while Trapaceae are considered to be a link between Onagraceae and Haloragaceae. Callitrichaceae are usually far removed from Haloragaceae in modern treatments, often being placed near Verbenaceae-Labiatae.

III. TAXONOMIC CRITERIA

GROSS MORPHOLOGY

Habit: Many accounts of the Haloragaceae describe the family as herbaceous, probably influenced to a large extent by the cosmopolitan genus *Myriophyllum*. However, the majority of the species and genera are characterised by a low shrub-like habit, with a perennial woody rootstock and usually herbaceous or woody annual stems. In some species of *Gonocarpus* (*G. halconensis, G. sanguineus*) and *Haloragis* (*H. exalata, H. erecta, H. uncatipila*) the branches are also more or less perennial, whereas the genus *Haloragodendron* is wholly shrubby or tree-like in habit (*H. racemosum* grows up to 3 m tall).

Rootstock: In herbaceous aquatic species (e.g. *Myriophyllum, Haloragis brownii*) the rootstock may be stoloniferous, although herbaceous terrestrial species are usually annuals. Shrubby or tree-like species (*Haloragodendron, Glischrocaryon,* most *Haloragis* and *Gonocarpus*) usually have a simple taproot system with laterals, and often in the shrubby species, adventitious roots from the nodes and/or internodes of the lower branches. However, particularly in *Haloragis* species from semi-arid regions (e.g. *H. aspera, H. glauca, H. heterophylla*), vegetative reproduction occurs from a deep horizontal network of underground stolons or roots. In non-stoloniferous species of *Haloragis* and *Gonocarpus,* the rootstock acts as a woody perennating organ, giving rise to new branches each growing season.

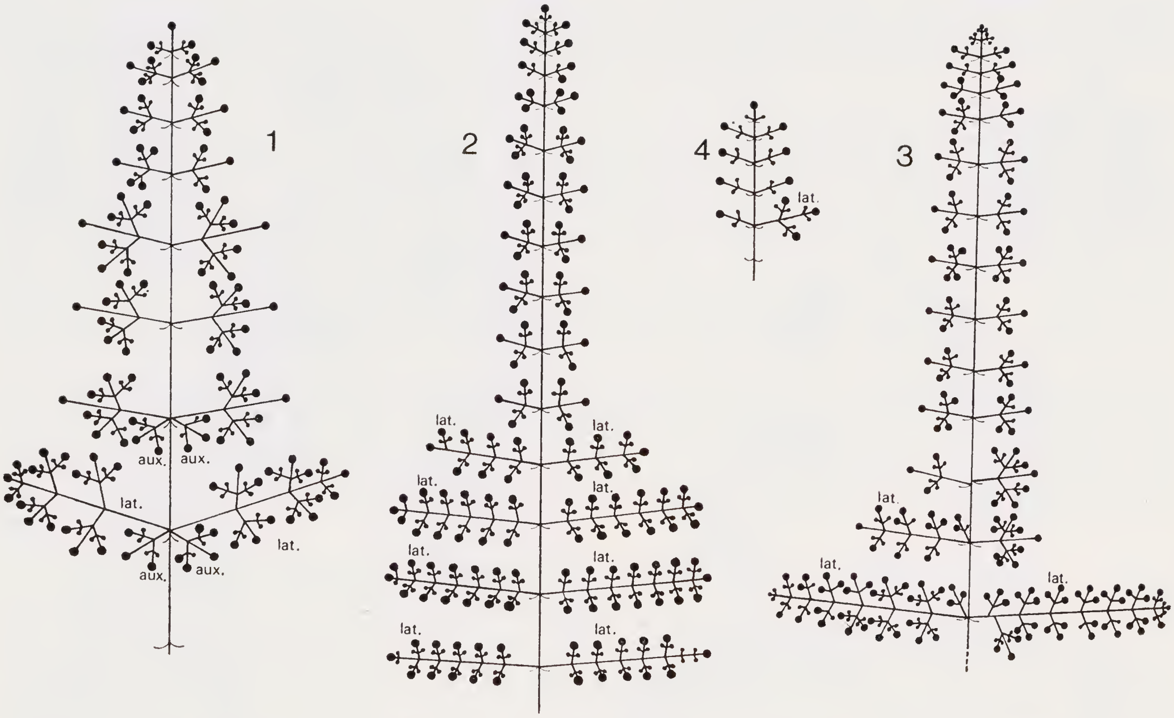
Indumentum: All species of *Myriophyllum, Glischrocaryon, Haloragodendron, Meziella* and *Proserpinaca* are glabrous. In the remaining three genera some species are glabrous, but most are more or less densely pilose or scabrous. The hairs are always simple and uniseriate, but differ from species to species in the number of cells (1 to *ca.* 6), length, colour (hyaline to opaque), texture (arachnoid to scabrous), and shape (straight, curved or hooked at the tip). In *Haloragis platycarpa* the hairs are unicellular, rounded, transparent and papillose, while in *Haloragodendron glandulosum* the leaves, stems and bracts are covered with large, red, globular, apparently glandular processes (although the plants are apparently not viscid).

Leaf arrangement: Of the genera of Haloragaceae, *Glischrocaryon, Proserpinaca* and *Meziella* consistently have alternate leaves, while *Haloragodendron* always has opposite leaves. *Haloragis, Laurembergia* and *Gonocarpus* species may have either alternate or opposite leaves, sometimes with both on the same plant, and then with the opposite arrangement at the base. *G. halconensis* and *G. sanguineus* (and rarely, *G. teucrioides*) have leaves in whorls of 3-4 or opposite. The leaves of *Myriophyllum* are usually whorled, but are alternate or opposite in some species.

Leaf shape: In *Glischrocaryon* the leaves are always sessile and linear to terete. This genus and *Haloragodendron* are characterised by their possession of both juvenile and adult leaf forms in some species. *Haloragis* and *Gonocarpus* have leaves of a wide variety of shapes, ranging from terete to linear, (ob-) lanceolate, (ob-) ovate, oblong, cordate or orbicular, entire or ± deeply dissected, multifid or pinnatifid, petiolate or sessile. The margins may be smooth or serrate. In *Haloragis* and *Haloragodendron* the teeth are usually deltoid or falco-deltoid, while in *Gonocarpus* the teeth are usually obliquely cuspidate. The leaves of *Glischrocaryon* are never serrate while those of *Haloragodendron* are never entire, and those of *Haloragis* and *Gonocarpus* are toothed in most species. The leaves of *Meziella* and *Proserpinaca* have a small tooth or spur in the angle between the segments which seems homologous with the "hydathodes" of *Myriophyllum*. The submerged leaves of *Myriophyllum* and *Proserpinaca* species are usually pinnatifid or multifid, while the emergent leaves are usually more or less entire.

Inflorescence: The basic unit of the inflorescence in this family is the dichasium, often compounded, rarely reduced. In *Haloragis* the inflorescence consists of dichasia of up to about 15 flowers borne in the axils of alternate primary bracts. The bracts are arranged along the distal portion of the upright annual stems, with reduction in size towards the apex. At the base of the inflorescence the primary bracts closely match the upper leaves in size and shape, but become reduced higher up. The inflorescence is indeterminate, growing continuously at the apex throughout the flowering season. Below the terminal inflorescence, lateral inflorescences, similar in construction to the main inflorescence but usually somewhat reduced in complexity, may be borne in the axils of the upper leaves. Within each fascicle of flowers, scale-like secondary, tertiary, etc, bracts occur at successive branchings.

The inflorescences of other genera can be derived by slight modifications of the situation in *Haloragis*. In *Haloragodendron* the primary bracts are always opposite, and the inflorescence is determinate, with a (usually) simple dichasium terminating the axis. The order of maturation of the flowers within the inflorescence in this genus varies from species to species (Figs. 1-4).



Figs. 1-4. Inflorescence structure in *Haloragodendron*. 1. *H. racemosum* (from *Orchard 1285*). 2. *H. monospermum* (from *Orchard 2389*). 3. *H. glandulosum* (from *Eichler 21106*). 4. *H. lucasii* (from *Blakely s.n.*, AD96920067). All with secondary and higher order bracts omitted. ● = functional flowers, • = rudimentary flowers, *lat.* = lateral inflorescence, *aux.* = auxiliary inflorescence.

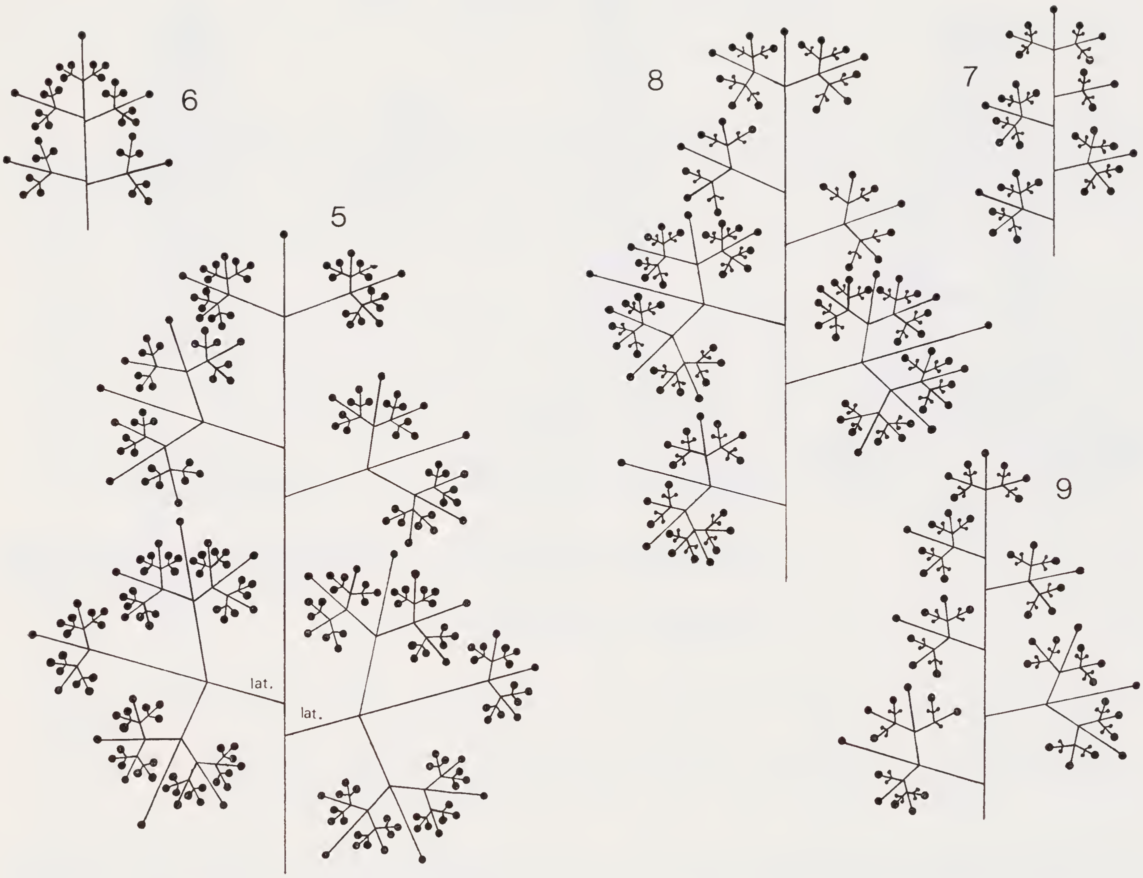
The inflorescence in *Glischrocaryon* also has a terminal dichasium, but in this genus it is a compound dichasium of up to 31 flowers. Below the terminal dichasium there are usually up to *ca.* 5 lateral dichasia in the axils of alternately arranged primary bracts, and below these there may be 2 or 3 lateral inflorescences in the axils of the upper leaves (Figs. 5-9). The main axis is contracted so that the entire inflorescence forms a more or less flat-topped pseudo-umbel. As well as their overall shape, the inflorescences of *Glischrocaryon* are unique in the family in that the primary (and sometimes secondary and tertiary) bracts are fused to the subtended peduncles for part of their length, and therefore appear to be displaced upwards by about half the length of the peduncle.

In *Gonocarpus* (with the exception of *G. hexandrus* and *G. paniculatus* the individual dichasia have been reduced relative to the situation in *Haloragis* and consist of single flowers in the axils of spirally or decussately arranged primary bracts. That this is probably derived and not the primitive condition within the family is indicated by the pair of sterile secondary bracts (= bracteoles) borne on the pedicel of each flower. As in *Haloragis,* there may also be lateral inflorescences arising from the axils of the upper leaves.

As far as can be determined, the situation in *Meziella* is as for *Gonocarpus,* but apparently there are no lateral inflorescences.

The inflorescence in *Laurembergia* agrees well with that of *Haloragis,* except that in the former the flowers are usually unisexual, the male flower occupying the terminal (central) position of each compound dichasium, standing out on a long pedicel from the almost sessile (lateral) female flowers. As in *Haloragis,* the main axis of the inflorescence is indeterminate, but there are few, if any, lateral inflorescences.

In *Proserpinaca* the inflorescence structure also agrees well with that in *Haloragis*. The main axis is indeterminate and the bisexual flowers are grouped in dichasia of 1-3 (-5) flowers in the axils of alternate primary bracts. Lateral inflorescences are rare.



Figs. 5-9. Inflorescence structure in *Glischrocaryon*. 5. *G. flavescens* (from *Orchard 1227*). 6. *G. aureum* var. *angustifolium* (from *Orchard 1702*). 7-9. *G. behrii* (7. from *Czornij 79*; 8. from *Donner 179*; 9. from *Kuchel 1412*). All bracts omitted. Symbols as for figs. 1-4.

The inflorescence in *Myriophyllum* represents a further modification of the system in *Gonocarpus*. In its simplest state, the *Myriophyllum* inflorescence consists of an indeterminate axis bearing single flowers (each with a pair of secondary bracts or bracteoles) in the axils of spirally or decussately arranged primary bracts. Only female flowers occur in the lower part of the inflorescence, male flowers in the upper part. In some species, bisexual flowers are found in the median portion of the inflorescence. More advanced species of *Myriophyllum* have an arrangement in the inflorescence that reflects the situation in the vegetative parts, where the leaves are whorled. In the inflorescences of these species, the primary bracts are also whorled, with only one flower per bract, and the distribution of sexes is the same as above.

The purely descriptive nature of the above account of inflorescence structure has been adopted in preference to classifying them as spikes, racemes, etc. It is an attempt show the basic similarity in structure in all genera, modified only by reduction in degrees of branching and in segregation of the sexes in some genera. This descriptive approach seems more appropriate to the comparative treatment of the species and genera aimed at here, than a typological classification according to the scheme of Troll (1964) outlined by Weberling (1965). If interpreted in terms of Troll's scheme, then the inflorescences of *Glischrocaryon* and *Haloragodendron* are monotelic and the "lateral inflorescences" are homologous with the axillary dichasia, all of them being termed paracladia. The *Glischrocaryon* type of inflorescence would be considered acrotonic while that of *Haloragodendron* would be basimesotonic. In *Haloragis, Gonocarpus, Laurembergia, Proserpinaca* and *Myriophyllum* the inflorescences would be termed polytelic with a terminal indeterminate main-florescence and (in some cases) lateral coflorescences ("lateral inflorescences").

Differences in structure and floral sex distribution within the inflorescence are useful in delimiting genera in this family (especially *Gonocarpus* - *Haloragis* - *Haloragodendron*), and differences in degree of branching have been found useful in distinguishing closely related species and taxa of lower rank (e.g. *G. sanguineus* - *G. halconensis*, and the subspecies of *G. micranthus*).

Floral sexual segregation: This is dealt with in part above (under Inflorescence). The flowers of all genera with the exceptions of *Myriophyllum* and *Laurembergia* are normally all bisexual. In *Laurembergia* one flower (usually the terminal one), in each dichasial fascicle is male or bisexual, while the others are female. In *Myriophyllum* the flowers at the base of the inflorescence are female while those at the apex are male, with sometimes a few bisexual flowers in the transitional region. In some species of *Gonocarpus* there is an apparent trend towards dioecy. Field studies revealed that in *G. tetragynus* all flowers on some plants had much reduced petals and non-functional anthers but apparently normal styles and ovaries, while other plants in the same populations had normal petals and functional anthers.

Examination of herbarium material shows that this phenomenon is fairly widespread in *Gonocarpus*, and that most species include a few plants with functionally female flowers. Reports in the literature of "male" and "female" flowers on the same plant in some species of *Haloragis* are erroneous. They arise from the fact that in *Haloragis* s. str. the ovary and styles are poorly developed until after the petals and stamens have been shed. The "male" and "female" flowers are in fact bisexual flowers at early and late stages of development.

Praglowski (1969) reported apparently abortive pollen from some flowers of *'Haloragis ciliata'* (= *H. acutangula*) and *'H. alata'* (= *H. erecta*). He found that flowers of the two species had both large and small anthers and that the abortive pollen came from the small anthers. Observations in the present study have revealed that in *Haloragis*, *Gonocarpus*, *Glischrocaryon* and *Haloragodendron* the antipetalous anthers are often 0.2-0.5 mm shorter than the antisepalous ones. However, Dr Praglowski (pers. comm.) has indicated that it is only in the species here included in *Haloragis* and *Gonocarpus* that the phenomenon of reduced pollen size regularly occurs. The extent of this apparent trend towards unisexual flowers is still unknown, but deserves further study for the light it could shed on generic relationships and direction in phylogeny. The presence of functionally unisexual flowers in some species should not be confused with the presence of small rudimentary flowers found in inflorescences of various species of *Haloragis*, *Haloragodendron* and *Glischrocaryon*. These are the flowers of the ultimate branchings of compound dichasia, and are fully differentiated when they abort well before anthesis, perhaps as a result of crowding or a nutritional deficiency.

The bisexual flowers of *Haloragis*, *Gonocarpus*, *Haloragodendron* and *Glischrocaryon* are protandrous; the petals and dehisced anthers being shed before the styles increase in size and become receptive. The situation in *Proserpinaca*, *Laurembergia* and *Meziella* is unknown. In *Myriophyllum* the female flowers develop in the lower part of the inflorescence before the male flowers in the upper part, and the plants are apparently protogynous.

Primary bracts: This term is used in the present treatment for the bract- or leaf-like structures on the rachis of the inflorescence. They subtend a partial inflorescence consisting of a simple or compound dichasium. Where the subtended axis bears more than one (compound) dichasium (i.e. is a side branch with two or more dichasia) it is here termed a lateral inflorescence, and the subtending structure called a leaf. Primary bracts are usually strongly reduced towards the apex of the inflorescence but at the base may be almost indistinguishable from the upper leaves. In plants with alternate leaves, the primary bracts are also alternate, but in those with opposite leaves the primary bracts may be alternate or opposite. The primary bracts, in the sense used here, are the same as the "floral leaves or bracts" of Bentham (1864) and the "bracteae" of Schindler (1905).

Secondary bracts: This term refers to the pair of small membranous bracts (= bracteoles) borne on the pedicel of the single flower in *Gonocarpus*, *Myriophyllum*, *Meziella* and some species of *Proserpinaca*, and to the homologous bracts subtending the first branching of a simple or compound dichasium in other genera. They are usually much smaller than the primary bracts.

Tertiary, quaternary bracts: These are the bracts subtending the second and subsequent branchings of compound dichasia in the genera *Haloragis*, *Glischrocaryon* and *Haloragodendron* which often have large fascicles of flowers in the axils of the primary bracts. The highest order bracts often lack a flower in their axils, or at most, subtend a precociously aborted flower.

Number of flower parts: The flowers of Haloragaceae are basically tetramerous, with four sepals, petals, styles and carpels, and eight stamens. No cases of 5-merous flowers are known in the family,

apart from some monstrous examples in *Haloragis acutangula*. However, reduction in the number of parts is fairly common. All species of *Proserpinaca, Gonocarpus hexandrus, Haloragis gossei, H. trigonocarpa, H. tenuifolia* and some flowers of *H. digyna* are reduced proportionately to a trimerous plan, while several species of *Myriophyllum, Haloragis brownii, Glischrocaryon behrii* and some flowers of *Haloragis digyna* are bimerous. In *Haloragis serra, H. stokesii* and *H. scoparia* the flowers are tetramerous except for the bilocular ovary, and in *H. eichleri* the otherwise tetramerous flower has an ovary in which one of the four locules fails to develop further during fruit formation. In *Gonocarpus nodulosus, G. philippinensis, G. humilis* and some species of *Myriophyllum* and *Laurembergia* the tetramerous flowers have only four, not eight, stamens. In *G. incanus* and *G. montanus,* one whorl of stamens is reduced to staminodes.

Sepals: These are present in the male and/or bisexual flowers of all species and persist in the fruit. They are absent only in the female flowers of *Myriophyllum*. Their shape ranges from lanceolate to deltoid, ovate or cordate, and a median rib, representing the median sepal vascular trace may or may not be apparent. In some species, particularly in those of *Gonocarpus,* the outer surface of the sepals may bear basal calluses (small swellings) in median or lateral positions. The shape, size and ornamentation of the sepals, while of unknown significance, is usually constant within a species, and can be useful taxonomic characters at this level.

Petals: The petals in Haloragaceae are characteristically folded conduplicately, keeled, hooded at the apex and shortly unguiculate at the base. They reflex strongly soon after anthesis and are shed with the stamens immediately after pollen dispersal. In *Glischrocaryon* they are bright yellow, as is the rest of the flower, but with the exception of this genus and *Haloragodendron,* the petals are usually green or reddish and probably have little function in attracting pollinators. In *Haloragodendron* the petals are usually creamy white in colour, and in common with those of *Glischrocaryon* are navicular (i.e. tapering towards the tip) rather than abruptly hooded in bud, and in some species of *Haloragodendron* (e.g. *H. lucasii*) are almost planar in the fully developed flower. *H. lucasii* is also noteworthy for the fact that its petals are twisted in bud, a condition that exists nowhere else in the family. Petals are absent in the female flowers of *Myriophyllum* and *Laurembergia,* and rudimentary or absent in the (bisexual) flowers of *Proserpinaca.*

Stamens: In Haloragaceae the stamens are typically twice the number of the sepals, petals and styles, with large oblong four-locular basifixed anthers on very short delicate filaments. In *Proserpinaca* the anthers are ellipsoid on relatively long filaments, and in this genus, as well as in *Haloragodendron* and *Glischrocaryon* the connective is produced above the pollen sacs to form a short apiculum. The antipetalous whorl of stamens is absent or rudimentary in *Proserpinaca, Meziella, Gonocarpus philippinensis* and some species of *Myriophyllum* and *Laurembergia,* while the antisepalous whorl of stamens is absent in *G. nodulosus,* and reduced to staminodes in *G. incanus* and *G. montanus.*

Styles: The styles in all species are the same in number as the locules and are free, with capitate or sub-globose, $\pm$ fimbriate stigmas. Development and maturation of the styles is delayed in bisexual flowers until the petals and stamens have been shed. The point of separation of the styles is just above the placental network of vascular traces, and some differences in mode of separation were noted during anatomical studies. In *Haloragis* (and *Gonocarpus micranthus*) the styles separate first in the central part of the stylar column, remaining attached together on their outer margins until the radial walls are completely separated. This results in the formation of a hollow column at the base of the styles. In *Haloragodendron* and *Glischrocaryon* the reverse is the case, where separation begins from the outside of the column, resulting in a solid, fluted column at the base of the styles. In *Gonocarpus* (with the exception of *G. micranthus*) the styles separate completely and simultaneously, with no stylar column or only a solid, round column.

Ovary: The ovary is fully inferior in all members of Haloragaceae, although the female flowers of *Myriophyllum,* which lack perianth and stamens, can only be considered inferior by analogy with other genera and the male flowers on the same plant. The number of locules is usually 4, but reduction to 3 or 2 occurs in some genera and species. In *Glischrocaryon* the ovary is effectively 1-locular by failure of the septa to develop, and in *Gonocarpus* the septa are only weakly developed (see below under Septa). Most literature reports give the number of ovules per locule as one in this family. However, it has become apparent during anatomical studies that in many (but not all) species of *Haloragis, Gonocarpus, Glischrocaryon, Haloragodendron* and *Proserpinaca* two ovules per locule are differentiated, but only one of the two develops fully and becomes vascularised. There is apparently no control over which of the

two will develop; the process is random. In the few species of *Myriophyllum* and *Laurembergia* examined, there has been only one ovule per locule differentiated, but a much wider survey is still needed in these genera.

SEPTA: The characteristics of the septa, in conjunction with the development of the seeds, provide some of the most reliable distinguishing features of the genera. In *Haloragis* the septa are solid and continuous for the entire length of the ovary, and consist of about six layers of cells. Each locule has a lining or epidermis of very small cubical cells, with about four layers of closely packed parenchyma making up the bulk of the septum. In the fruit the septa maintain the same position as in the flower, the individual cells, particularly the lining cells, become lignified and the pith in the placental column breaks down leaving a hollow tube ('columella').

In *Haloragodendron* the structure of the septum is very similar to that in *Haloragis,* although the packing cells may consist of up to seven layers. During fruit development only the lining cells become lignified, resulting in a flexible septum which is pushed to one side by the developing single seed. The pith in the placental column does not break down as in *Haloragis.*

Gonocarpus has a greatly reduced septal structure. There is little or no evidence of any septum in the middle of the ovary, the placental supply passing upwards as a free cord. At the top and bottom of the ovary four locules are formed by an insubstantial septum consisting of loose aggregations of cells reminiscent of fungal hyphae or spongy parenchyma of leaves. This weakly developed septum is easily crushed by the single seed in the fruit.

Septa are completely absent in the ovaries of most flowers of *Glischrocaryon,* but in *G. flavescens* incomplete septa may be present at the extreme top and bottom of the ovary and as small ridges running down the inner wall. These septa are similar in structure to those of *Haloragis* and *Haloragodendron* and their lining cells become very heavily lignified in the fruit.

Laurembergia completely lacks septa in the ovary, while *Proserpinaca* has septa apparently agreeing well with those in *Haloragis.* In *Myriophyllum* the septa are relatively thick, and become heavily lignified throughout before the fruit splits along them into nutlets. The situation in *Meziella* is unknown apart from Schindler's statement that the ovary is four locular with four ovules.

POLLINATION: Haloragaceae is usually considered to be anemophilous, judged on its reduced, insignificant flowers, large anthers borne on weak filaments, and fimbriate stigmas. Schindler (1905) and Praglowski (1970) considered that *Glischrocaryon* and the species of *Haloragis* now placed in *Haloragodendron* were probably entomophilous, basing this judgment on the showy petals of these plants. Field observations during the present study, as well as collectors' notes, have revealed that bees are attracted by the abundance of pollen to flowers of at least some species of *Haloragis, Gonocarpus* and *Myriophyllum* (particularly *H. acutangula, G. elatus, M. propinquum*). Thus while anemophily may be the usual situation in this family entomophily is also a factor.

FRUIT: The fruits of *Myriophyllum* split septicidally at maturity to form (2-3-) 4 nutlets. With this exception the fruits of Haloragaceae are indehiscent. In *Gonocarpus* and perhaps *Laurembergia* the fruit differs from the ovary in its more woody nature, but hardly at all in size or shape. In all other genera there is at least a two-fold, and often three- to five-fold, increase in the size of the fruit over that of the ovary. This is particularly important as a distinguishing character between *Gonocarpus* and *Haloragis.*

There is considerable variety of form and sculpturing in the fruits of the Haloragaceae, and this has been used by various authors in distinguishing species (and to a lesser extent, genera: e.g. A. P. de Candolle (1828)). All species of *Glischrocaryon,* most of *Proserpinaca* and *Haloragodendron* and some species of *Haloragis* and *Myriophyllum* have winged fruits, while species of *Haloragis, Gonocarpus, Laurembergia* and *Myriophyllum* are noted for the variety of tubercular, rugose, costate and channelled ornamentations of their exocarp. While these markings are usually constant within a species, in some species of *Haloragis* (e.g. *H. acutangula, H. erecta, H. odontocarpa, H. aspera*) a marked degree of fruit polymorphism is found even in small populations. This has been catalogued in the present study by recognising a number of formae based on fruit characters alone (see under the species cited above for further discussion).

The nature of the pericarp also varies considerably. In *Gonocarpus* the wall of the fruit is relatively thin and submembranous, and can be readily crushed between the fingers. In *Haloragis* the fruit consists of an inner (endocarp) layer which is extremely woody, with an outer "skin" (exocarp) closely appressed.

In some species of *Haloragis, Glischrocaryon* and *Haloragodendron* the exocarp is habitually or occasionally extremely swollen and spongy in texture, with a normal woody endocarp. The function or significance of the swollen exocarp is not known.

SEED: The number of seeds developed per fruit varies with the genus. In *Haloragis* (with the exception of *H. eichleri*) all locules develop fully in the fruit and each has the potential to contain a seed, resulting in a possible four seeds per fruit (in fact many fruits contain only one, two or three seeds, but the empty locules still develop normally). In *Haloragodendron* only one of the four functional ovules develops to a seed, suppressing the growth of any other fertilised ovules at an early stage. The single seed occupies the whole fruit, displacing the septa to one side. Similarly, in *Glischrocaryon, Gonocarpus* and *Laurembergia* only a single ovule per fruit develops to form a seed, and fills the whole fruit. In *Proserpinaca* (and *Haloragis eichleri*) there is the potentiality for a seed to develop in each locule, but if one (or more) locules are empty then their further development is retarded, and the fruit develops irregularly.

FLORAL VASCULAR ANATOMY

A survey was made of the floral vasculature of a range of species of Haloragaceae and putatively related families in the hope that additional characters could be found that would be of use in determining species, genus and family relationships. The species examined and the location of voucher specimens are given in Table 1.

Table 1. List of vouchers for floral vascular anatomy.

Unless stated otherwise, only one flower of each collection was sectioned. An asterisk (*) signifies that material from herbarium sheets was used; all other material was preserved in F.A.A.

Name	Collection	Voucher
Haloragis		
H. exalata		
var. *exalata*	Orchard 2011, Moleside Ck., Victoria	AD
H. erecta		
subsp. *erecta*	Orchard 2417, Cultivated, Adelaide Bot. Gdn.	AD
	Sneddon s.n., Nth. Is., New Zealand	WELT
H. eichleri	Eichler 20806, Robe, S.A.	AD
H. odontocarpa		
f. *pterocarpa*	Henderson s.n., 50 km N. Barmera, S.A.	AD
	Orchard 1859, 3 km S. Waikerie, S.A.	AD
H. gossei	Nelson 1738, 1½ mls. N. Connors Well, N.T.	AD
H. trigonocarpa	Orchard 1263, 31 km N. Widgiemooltha, W.A.	AD
H. acutangula		
f. *acutangula*	Orchard 1871, 18 km E. Murray Bridge, S.A.	AD
	Orchard 2821, 5 km S.W. Edithburgh, S.A.	AD
	Orchard 2824, 2 km W. Wattle Point, S.A.	AD
	Orchard 2852, 3 km N.E. Stenhouse Bay, S.A.	AD
	Orchard 2860, Brown's Beach, S.A.	AD
	Orchard 2867, Hardwicke Bay, S.A.	AD
H. acutangula		
f. *tetraptera*	Orchard 1853, 16 km W. Waikerie, S.A.	AD
	Orchard 1873, 15 km S. Waikerie, S.A.	AD
	Orchard 2812, 4 km W. Pine Point, S.A.	AD
H. aspera	Orchard 2587, 10 km S.E. Curramulka, S.A.	AD
H. uncatipila	Orchard 900, 24 km N. Tennant Ck., N.T.	AD
H. hamata	Orchard 1725, Loc. 1160, Shire of Oldfield, W.A.	AD
H. heterophylla	Orchard 2636, Wulgulmerang, Vict.	AD
H. myriocarpa	Beauglehole 33405, Kentbruck Heath, Vict.	BEAUG
H. digyna	Copley 2978, 16 mls. E. Yeelanna, S.A. (8 flowers)	AD
H. brownii	Orchard 2018, Long Swamp, Vict.	AD
Haloragodendron		
H. baeuerlenii	Beauglehole 33376, Suggan Buggan, Vict.	AD
	Orchard 2647, Mt. Wheeler, Vict.	AD
	Orchard 2785, Ballantyne Hills, Vict.	AD
H. racemosum	Orchard 1285, Boyatup Hill, W.A. (4 flowers)	AD
H. monospermum	Orchard 2389, Corang River, N.S.W.	AD
	*Wrigley CBGO23487, Corang River, N.S.W.	CBG
H. glandulosum	Eichler 21106, Kundip, W.A.	AD

Name	Collection	Voucher
Glischrocaryon		
G. behrii	Orchard 1805, 3½ miles S. Monarto South, S.A. (4 flowers)	AD
	Orchard 2586, 10 km S.E. Minlaton, S.A.	AD
G. aureum var. *angustifolium*	Orchard 1703, Location 1163, Shire of Oldfield, W.A. (3 flowers)	AD
G. flavescens	Orchard 1227, Location 1105, Shire of Esperance, W.A.	AD
	Orchard 1799, 26 m. N. of Minnipa, S.A.	AD
Gonocarpus		
G. micranthus subsp. *micranthus*	Orchard 1905, Glenelg River, Vict. (5 flowers)	AD
	Sneddon s.n., North Isl. N.Z.	WELT
subsp. *ramosissimus*	Orchard 2383, Evans Head, N.S.W.	AD
G. mezianus	Orchard 1810, 10 km S.E. Finnis, S.A.	AD
	Orchard 2583, 6 km N.W. Stansbury, S.A.	AD
G. teucrioides	Orchard 2347, Springbrook, Qld.	AD
G. elatus	Orchard 1823, 1 km from Cherryville, S.A.	AD
	Orchard 2780, Bald Hill, Vict.	AD
G. pycnostachyus	Orchard 1079, 12 km S.E. Condingup Peak, W.A.	AD
	Eichler 20096, Big Is., Duke of Orleans Bay, W.A.	AD
G. tetragynus	Orchard 1824, Montacute road, S.A.	AD
	Orchard 2388, 6½ km S. Coffs Harbour, N.S.W.	AD
	Orchard 2394, River Corang, N.S.W.	AD
G. humilis	Eichler 20717, Atherton State Forest Res. 194, Qld.	AD
G. chinensis subsp. *verrucosus*	Orchard 2385, 5 km S. Yamba, N.S.W.	AD
G. nodulosus	Orchard 1080, 12 km S.E. Condingup Peak, W.A. (3 flowers)	AD
G. cordiger	*Pritzel 145, Darling Range, W.A. (2 flowers)	AD
G. cf. *montanus*	Sneddon s.n., North Island, N.Z.	WELT
Proserpinaca		
P. platycarpa	*Killip 41122, Florida Keys, U.S.A.	US
P. palustris var. *crebra*	*Cook & Griggs 429, Guatemala	US
P. pectinata	*Chickering US1383839, Manchester, New Jersey, U.S.A.	US
Laurembergia		
L. repens ♀	*Hildebrandt 3647, Madagascar (3 flowers)	US
L. tetranda ♀	*Hatschbach 5133, Parana, Brazil	US
♂	*Hatschbach 5133, Parana, Brazil	US
Trapaceae		
Trapa bicornis	Tun-Yee, Mandalay, Burma	AD
Cornaceae		
Cornus alba	Orchard 2589, Cultivated, Adelaide	AD
Corokia buddleoides	Sampson s.n., Wellington, New Zealand (2 flowers)	WELT
Rhizophoraceae		
Rhizophora mucronata	Darbyshire 620, Kanosia, Papua	CANB
Bruguiera exaristata	Schodde 2735, Ding Hou, Papua	CANB
Combretaceae		
Lumnitzera littorea	Hoogland 4377, Papua	CANB
Araliaceae		
Tieghemopanax sambucifolius	Schodde 3244, Barrington Tops, N.S.W. (2 flowers)	CANB
Gunneraceae		
Gunnera macrophylla ♀	Hoogland 9551, Terr. of New Guinea (2 flowers)	CANB
Gunnera macrophylla ♂	Hoogland 9551, Terr. of New Guinea (2 flowers)	CANB
Callitrichaceae		
Callitriche stagnalis	Ising s.n. Mt. Lofty Ra., S.A. (4 flowers)	AD
	Orchard 2590, Waite Institute, S.A. (2 flowers)	AD
Callitriche sonderi	Eichler 13798, 6.5 km W. Berri, S.A. (2 flowers)	AD

Where possible flowers and buds collected in the fresh state and preserved in F.A.A. for at least 24 hours were used. This material was dehydrated in a T.B.A. series, embedded in paraffin and serial sections cut at 10-12 μ. The sections were stained with safranin-fast green and mounted in XAM. Where pickled material was not available, herbarium material was rehydrated by the method of J. L. Cunningham (1969). After rehydration and washing, the material was placed in F.A.A. for 12 hours and then treated as for fresh preserved flowers. The results obtained by this method were satisfactory, although cell detail was not quite as good as that in fresh material. Flowers and buds rehydrated from herbarium material are marked with an asterisk (*) in Table 1.

The large number of species of Haloragaceae sectioned makes it difficult to present the patterns of variation through the family in a surveyable manner. For this reason the descriptions below start, in each genus, with a general account, followed by notes on deviations from this pattern in individual species. In other families, where a more restricted range of material was studied, a brief description of the species examined is followed by a discussion of reports of other workers, where these reports are available.

Haloragaceae

Haloragis: The vascular tissue enters the flower as a single solid bundle, more or less circular in cross-section, and divides radially into 8 bundles, 4 antisepalous and 4 antipetalous. At the base of the locules the antisepalous bundles each give rise to an inner branch, and these fuse and enter the columella as a single placental bundle. The antipetalous bundles and the remainder of the antisepalous bundles continue upwards through the ovary wall until the top of the locules, where the antisepalous bundles split off an inner and an outer branch, the antipetalous bundles forming an inner branch only. The remainder of the antisepalous and antipetalous bundles fuse laterally to form an annulus which passes between the branches of the antisepalous bundle and outside the branch of the antipetalous bundle. The outer branch of the antisepalous bundle passes into the sepal as the median sepal trace, while the inner branch enters the adjacent stamen as the antisepalous stamen trace. Above the annulus the branch of the antipetalous bundle divides simultaneously into three radially arranged traces. The outer and central branches are the largest and form the petal trace and antipetalous stamen trace respectively. The inner branch enters the base of the style as the dorsal style trace.

At about the same level as the annulus the placental bundle divides into four more or less horizontal arms running along the top of the septa towards the sepals. Each branch divides dichotomously near the outer wall of the locules and each branch then divides again, the outer sub-branch passing obliquely upward around the outer wall of the locule to fuse with its adjacent sub-branch and the dorsal stylar trace to form a compound dorsal stylar bundle, while the inner sub-branches travel around the inner wall of the locule, adjacent traces fusing to form 4 complete circumlocular traces. Usually 2 ovules are differentiated in each locule, the placentation being pendulous, from the radial walls. One ovule aborts at a very early stage and is not vascularised. The other is supplied with an ovular trace from the inner side of the circumlocular trace.

No lateral stylar traces are formed from the placental network, the styles being served only by the compound dorsal stylar bundle which runs the length of the style and may branch somewhat towards the tip.

H. exalata var. *exalata*: The vascular plan of this species agrees with the general plan for the genus with the exception of the dorsal stylar trace. In this species the portion of the circumlocular trace on the outer side of the locule is absent, or very weakly devel ped, with the result that the entire dorsal stylar bundle is derived from the innermost branch of the anti-petalous bundle. Two ovules per locule are differentiated, but one aborts at an early stage of development and is not vascularised. Two lateral sepal traces per sepal are derived in the usual manner from the annulus.

H. erecta: This species conforms closely with the generic pattern. It differs in having the columellar bundle derived simultaneously with the antisepalous and antipetalous bundles from the pedicel bundle. As in *H. exalata*, the outer part of the circumstylar trace is not, or only very weakly developed. Two ovules per locule are differentiated, but one aborts at a very early stage and is not vascularised. Two lateral sepal traces per sepal are derived from the annulus.

H. eichleri: The floral vasculature of this species follows the general generic pattern. Only one ovule per locule is differentiated, and two lateral sepal traces per sepal are derived from the annulus. The annulus in this species is slightly weaker than normal in *Haloragis*.

H. odontocarpa f. *pterocarpa*: The vascular structure of this species fits almost exactly the general structural plan for the genus. The only anomalous feature occurs in the vascularisation of the styles, where in addition to the normal dorsal stylar trace an extremely small lateral stylar trace is derived from the placental network. It is apparently cut off at the first dichotomy of each of the four major branches of the columellar bundle, towards the outer edges of the septa. Each trace then travels upward into the base of the stylar column, and finally divides into two branches before entering adjacent styles. Each style thus has a compound dorsal bundle plus two lateral traces. Each sepal has two lateral sepal traces derived in the normal way from the annulus, but these peter out just above the base of the sepal. Apparently only one ovule per locule is differentiated.

H. gossei: This species conforms to the general pattern except for modifications caused by its trimerous floral plan, and the presence of the large wings. The vascular structure reflects the reduction in gross morphology from a basic number of four parts to a basic number of three. The placental bundle is formed from the antisepalous traces in the normal way but the three traces remain more or less distinct throughout the length of the columella. The wings are vascularised by 4-5 lateral traces derived from the antipetalous bundle. As the traces move out into the wing they divide and anastomose, decreasing in size and forming no distinct marginal vein. Only 1 ovule is differentiated in each locule. Two lateral sepal traces are cut off from the annulus in the normal way (Fig. 12).

H. trigonocarpa: Along with *H. gossei*, this species forms a distinct group within the genus, but differs from *H. gossei* in several aspects of its floral vascular anatomy. As in *H. gossei* the vascular framework is built on a trimerous pattern, but the antisepalous bundles consist of two more or less distinct, tangentially arranged, parallel vascular strands, and the antipetalous bundles of three similarly arranged strands. At the level of the annulus the two strands of each antisepalous bundle each form an inner and outer branch, the two inner branches fusing to form the antisepalous stamen trace, the outer branches fusing with each other and with a branch from each of the adjacent lateral antipetalous bundles to form the median sepal trace. The remainder of the lateral antipetalous bundle fuses with the equivalent branch of the other lateral bundle within the same antipetalous bundle to form the dorsal stylar trace. This then fuses with elements of the placental network in the normal way to form the compound dorsal stylar bundle. The median strand of the antipetalous bundles divides to form the petal trace and the antipetalous stamen trace. *H. trigonocarpa* has no lateral sepal traces. The wings are vascularised by a series of 3-4 lateral veins derived from all three strands of the antipetalous bundle. The lateral veins fuse along the margin of the wing to form a distinct intra-marginal vein. As in *H. gossei* the placental bundle consists of three distinct strands for its entire length. Two ovules per locule are differentiated but one aborts and is not vascularised (Fig. 11).

H. acutangula: This species agrees in its floral vascular anatomy with the general pattern for the genus, except in having (in most cases) only one ovule differentiated per locule. Each sepal has two lateral sepal traces (rarely none), derived from the annulus.

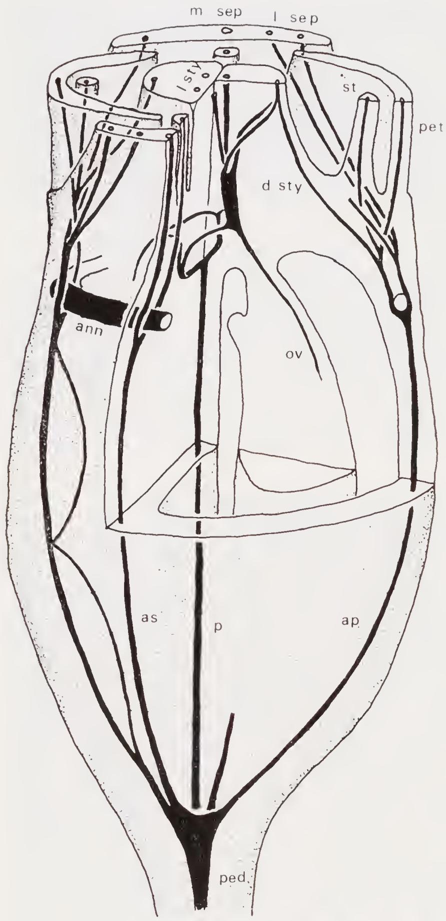
H. aspera: This species deviates from the general plan only in that the placental bundle consists of four more or less distinct strands for its entire length. The abortive ovule in each locule is weakly vascularised. Two lateral sepal traces per sepal are derived from the annulus.

H. uncatipila: This species agrees in all respects with the general generic pattern. Two ovules per locule are differentiated, but only one is vascularised and functional. Two lateral sepal traces per sepal are derived from the annulus.

H. hamata: The floral vasculature of this species agrees with the general generic pattern except as modified by the reduction of the flower from a 4-merous to a 2-3-merous condition. There is also some disruption in the organisation of the stylar trace. In one flower, one of the dorsal stylar bundles was derived from the antisepalous bundle instead of the antipetalous bundle, and in another flower, the dorsal stylar trace was formed entirely from the branches of the placental network. Two ovules per locule are differentiated, and both are vascularised. Two lateral sepal traces per sepal are derived from the annulus.

H. heterophylla: This species follows the general plan for the genus in its floral vasculature. Two ovules per locule are differentiated but the abortive one is not vascularised. Two lateral sepal traces per sepal are derived from the annulus.

H. myriocarpa: In this species the antisepalous, antipetalous and placental bundles depart more or less simultaneously from the pedicel bundle, although throughout its length the placental bundle consists of 4 distinct strands. The dorsal stylar trace from the placental network does not fuse completely with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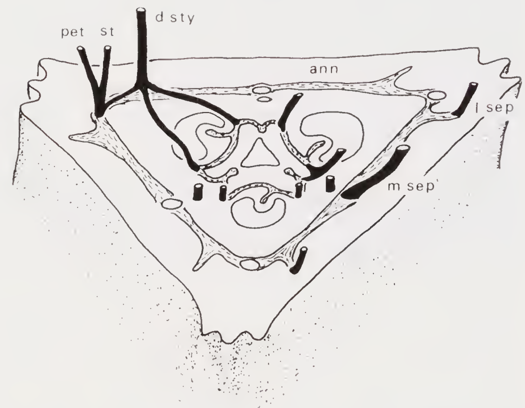
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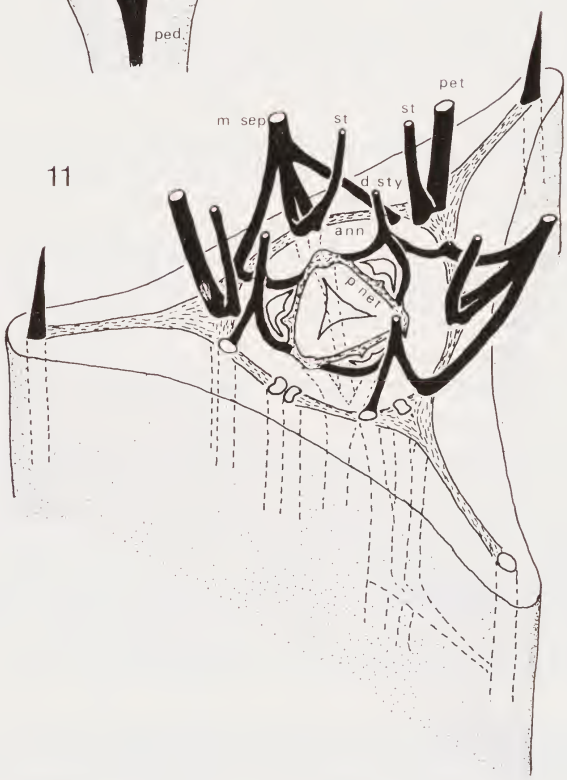
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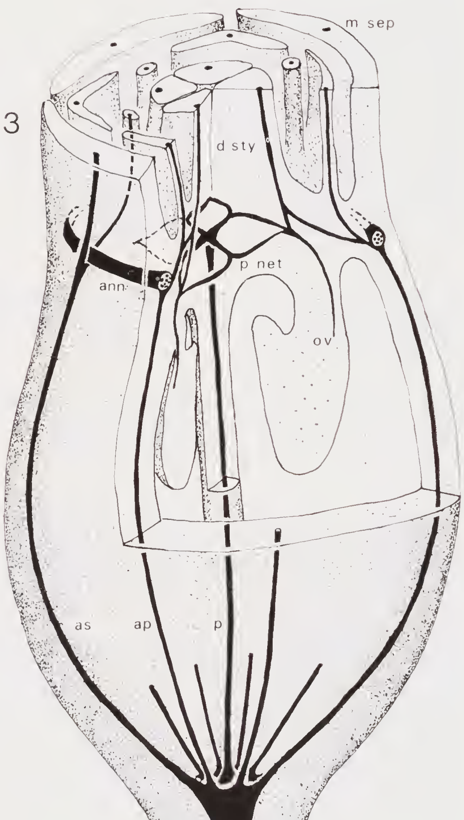
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the branch from the antipetalous bundle, but both divide in the upper part of the styles to form lateral stylar traces. Two ovules per locule are differentiated, one ovule aborting at an early stage of development. However, the abortive ovule may be faintly vascularised. Each sepal is supplied with two lateral sepal traces.

H. digyna: Both bimerous and trimerous flowers are found on the same plant in the species, with the resultant difference in number of antipetalous and antisepalous strands. Furthermore, in most of the flowers sectioned, all but one of the locules had aborted at an early stage, causing severe distortion of the vascular system. As herbicide damage is suspected, no importance is attached to the deformed flowers. In a normal bimerous flower it was found that the basic pattern was as for the genus, except in the placental system. Here four distinct traces run the length of the ovary, with fusion in pairs at the top between the two strands adjacent to each locule. A trace to the ovule (1 per locule) is then formed from the fusion strand, the remainder of the vascular material then dividing and passing around the locule wall to fuse with the dorsal stylar trace in the normal way.

H. brownii: The vascular pattern of the flower of this species deviates further from the general pattern for the genus than does that of any other species, probably as a result of the reduction in number of parts. The placental bundle is very small. At the top of the locules it forms two horizontal arms which travel along the septa before dividing dichotomously at the outer limits of the locules. The branches then turn slightly upwards and return around the inner side of the locules, dividing again in a more or less vertical plane. The lower branches of this second dichotomy continue around the inner wall of the locule to form the inner part of the circumlocular trace, while the upper branches travel obliquely up and around the base of the style to fuse with each other and with a branch of the antipetalous bundle to form the compound dorsal stylar trace in the normal way. At the second dichotomy, at either end of the circumlocular trace, a small vertical trace is also cut off which travels upwards unbranched as a lateral stylar trace. The lateral stylar traces of *H. brownii* thus differ from those of *H. odontocarpa*, *Haloragodendron* and *Glischrocaryon* where the traces originate from the first dichotomy and divide to pass into adjacent styles. *H. brownii* also has a very weakly developed annulus, which plays no part in the vascularisation of the sepals. Instead the antipetalous bundle forms an outer branch just below the annulus (*H. brownii* differing in this respect from all other species of *Haloragis*) and this branch divides laterally just above the annulus to pass into opposite sepals as lateral sepal traces. The lateral sepal traces may divide again almost immediately, so that each sepal has two to four lateral sepal traces. The median sepal trace originates from the outer branch of the antisepalous bundle in the normal way. Two ovules per locule are differentiated, but one aborts at a very early stage and is not vascularised (Fig. 10).

Haloragodendron: The vascular tissue enters the flower as a single solid bundle from the pedicel. At the base of the locules it divides radially to form eight bundles, four antisepalous bundles alternating with four antipetalous bundles. The remainder of the vascular tissue continues upward and enters the columella as four more or less distinct placental bundles.

The antisepalous and antipetalous bundles travel upward through the outer ovary wall until just below the base of the sepals. At this point the antisepalous and antipetalous bundles divide to form an inner and an outer branch, the remainder of the vascular tissue fusing laterally to form an annulus which passes between the inner and outer branches. The outer branches of the antisepalous and antipetalous bundles pass into the sepals and petals as the median sepal trace and the petal trace respectively. The inner branch of the antisepalous bundle passes into the adjacent stamen as the antisepalous stamen trace, while the inner branch of the antipetalous bundle divides again, the outermost sub-branch forming the antipetalous stamen trace, the innermost sub-branch entering the stylar column as the dorsal stylar trace.

The placental bundle travels some distance up into the stylar column before dividing to form four more or less horizontal branches. These branches pass along the tops of the septa before branching dichotomously near the outer walls of the locules. The secondary branches divide again, one tertiary branch travelling horizontally around the inner wall of the locule and fusing with its adjacent equivalent branch, the other tertiary branch turning vertically upward and entering the style as a lateral

Figs. 10-13. Reconstruction, from serial sections, of the vascular structure of flowers of *Haloragis* and *Gonocarpus*. 10. *Haloragis brownii* (from *Orchard 2018*). 11. *H. trigonocarpa*, top of the ovary (from *Orchard 1263*). 12. *H. gossei*, top of the ovary (from *Nelson 1738*). 13. *Gonocarpus nodulosus* (from *Orchard 1080*). Abbreviations: *ann.* = annulus, *a.p.* = antipetalous bundle, *a.s.* = antisepalous bundle, *ax.* = axial bundle (stele), *d.* = disc, *d. sty.* = dorsal stylar trace, *g.* = girdle, *l. sep.* = lateral sepal trace, *l. sty.* = lateral stylar trace, *m. sep.* = median sepal trace, *ov.* = ovule trace, *p.* = placental bundle, *ped.* = pedicel bundle, *pet.* = petal trace, *p. net.* = placental network, *st.* = stamen trace, *sty.* = stylar trace.

stylar trace. The ovule trace originates at the second dichotomy of the placental network. Thus in *Haloragodendron* no vascular tissue derived from the placental network passes around the outer wall of the locule, and the dorsal stylar trace consists only of the branch from the antipetalous bundle. The lateral sepal traces are derived from the annulus.

H. racemosum: The major difference between the vascular pattern in this species and that of the generalised type, lies in slight modification to the placental network. Only one functional ovule per locule is differentiated, and these are so arranged that they are vascularised by two opposite primary branches. These two branches pass along the top of the septa in the normal way, but at the first dichotomy, the secondary branches go directly to the ovules. At the same point a vertical bundle is cut off which divides immediately to form lateral stylar traces for adjacent styles. The other two primary branches pass along the septa to form lateral stylar traces only. Thus in this species there has been a total suppression of the circumlocular tertiary branches of the placental network. The number of lateral sepal traces varies in the same flower from four to six. Two ovules per locule are differentiated, one slightly higher than the other, but only the lower one develops to become vascularised. Only one of the four functional ovules in each flower develops to form a seed (Fig. 15).

H. baeuerlenii: This species agrees with the generalgeneric description in all details. Only one ovule per locule is differentiated. No lateral sepal traces exist. The lateral stylar traces in this species are weak and only extend for a short distance into the styles (Fig. 16).

H. monospermum: This species agrees well with the general pattern, differing only slightly in the derivation of the antipetalous bundles. At the base of the locules apparently only the placental bundle and the four antisepalous bundles are formed from the pedicel bundle. As the antisepalous bundles move outwards they cut off a lateral bundle on either side, and these fuse in adjacent pairs to form the antipetalous bundles. Two ovules per locule are differentiated, one slightly above the other. The upper one aborts at an early stage and is not vascularised, or has only a very faint trace. About four lateral traces per sepal are cut off from the annulus.

H. glandulosum: The floral vasculature of this species agrees with the general generic pattern except that it lacks lateral stylar traces. Thus the placental supply is completely used up in supplying the ovules. Only one ovule per locule is differentiated, and no lateral sepal traces are formed from the annulus.

Glischrocaryon: Vascular tissue enters the flower as a single solid cylinder from the pedicel. Below the locules eight radiating bundles are formed, four antisepalous bundles alternating with four antipetalous bundles. The remainder of the vascular tissue passes on upward into the columella as a single placental bundle. After travelling up through the outer walls of the ovary, the antisepalous and antipetalous bundles divide just below the top of the locules, the antisepalous bundles forming an inner and an outer branch, and antipetalous bundles forming inner branches only. The remainder of the vascular tissue fuses laterally to form an annulus which passes between the branches of the antisepalous bundle and outside the antipetalous bundle branch. The outer branch of the antisepalous bundle enters the sepal as the median sepal trace while the inner branch forms the antisepalous stamen trace. The branch of the antipetalous bundle divides into three radially arranged strands, the outermost forming the petal trace, the central one entering the adjacent stamen as the antipetalous stamen trace, and the innermost passing into the stylar column as the dorsal stylar trace. Slightly above the level of the annulus, the placental bundle divides to form four more or less horizontal branches which travel outwards along the top of the septa. Near the outer walls of the locules the primary branches divide dichotomously, the secondary branches travelling around the outer wall of the locules to fuse with their adjacent equivalent branches, and with the dorsal stylar trace to form a compound dorsal stylar bundle. Lateral stylar traces are cut off either at the first dichotomy as a single bundle which divides as it travels upwards, with a branch passing into two adjacent styles, or else the lateral stylar traces are distinct from the beginning and originate independently from the secondary branches, just after these have separated. The lateral sepal traces arise from the annulus. As there is no inner circumlocular tertiary branch of the placental network, the ovular traces are cut off from the primary branches just before they fork.

G. flavescens: This species agrees closely with the general pattern of floral vascular anatomy. Two ovules per locule are differentiated but one aborts at an early stage and is not vascularised. The lateral stylar

Figs. 14-18. Reconstruction, from serial sections, of vascular structure at the top of the ovary in Haloragaceae. 14. *Gonocarpus pycnostachyus* (from *Orchard 1079*). 15. *Haloragodendron racemosum*, base of stylar column (from *Orchard 1285*). 16. *Haloragodendron baeuerlenii* (from *Beauglehole 33376*). 17. *Glischrocaryon flavescens* (from *Orchard 1799*). 18. *Proserpinaca palustris* var. *crebra* (from *Cook & Griggs 429*). Abbreviations as for Figs. 10-13.

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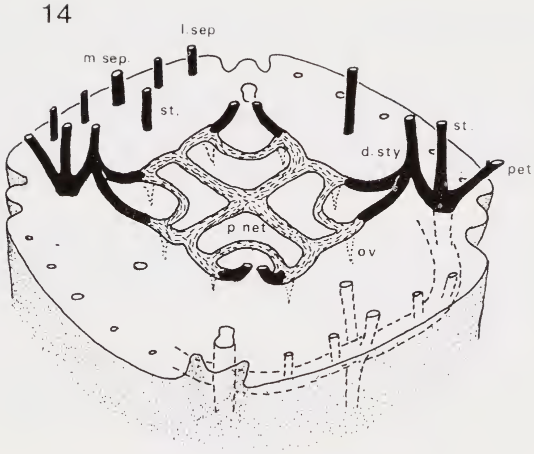
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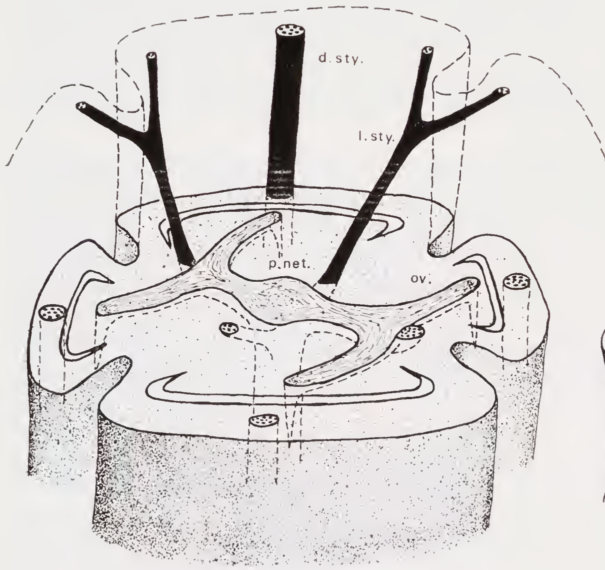
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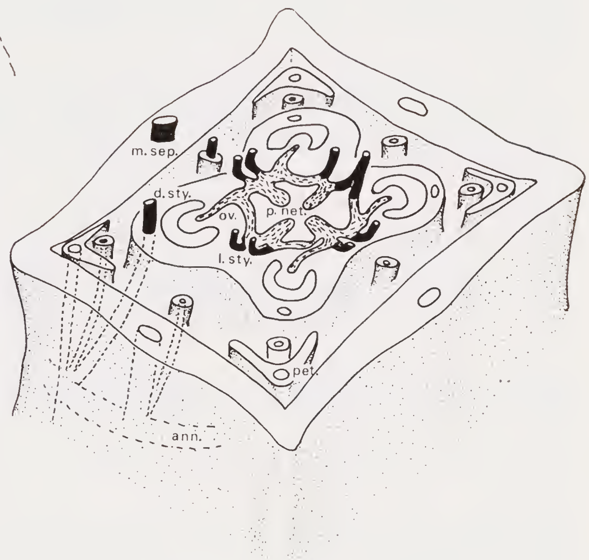
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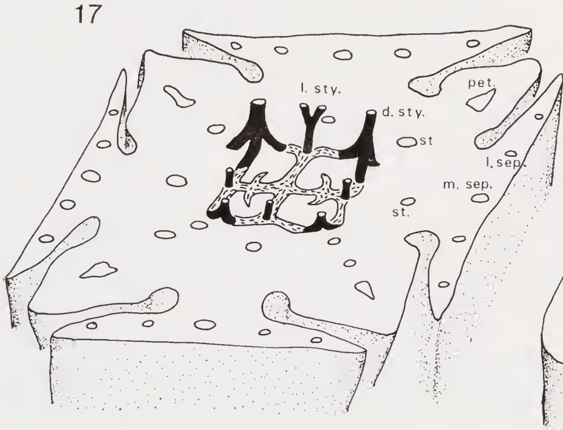
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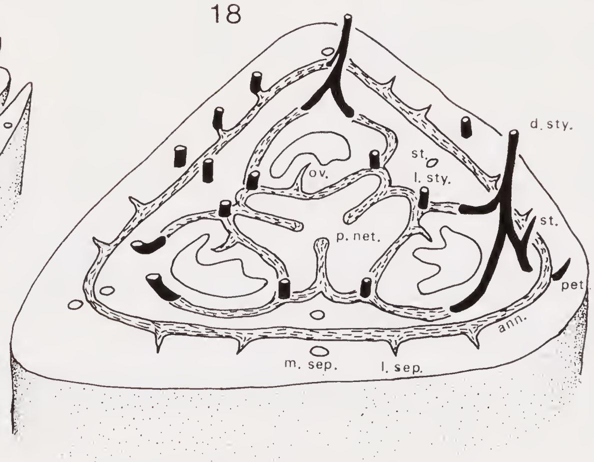
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traces can be of either of the two types described in the general account. Four lateral sepal traces per sepal are formed (Fig. 17).

G. aureum var. *angustifolium*: This taxon agrees well with the general pattern. Two ovules per locule are differentiated but one aborts at an early stage and is not vascularised. The lateral stylar traces originate as a single bundle at the dichotomy of the primary branches of the placental network and divide to pass into adjacent styles. Five or six lateral sepal traces per sepal are formed.

G. behrii: Except in its reduction from a 4-merous to a 2-merous plan, the floral vascular structure agrees exactly with that of the other species. Two ovules per locule are differentiated, but one aborts before being vascularised. Four to six lateral sepal traces are formed. The lateral stylar traces arise independently from the secondary branches of the placental network.

Gonocarpus: The vascular tissue enters the flower as a single solid bundle. Below the locules eight lateral bundles are cut off, four antisepalous bundles alternating with four antipetalous bundles, these bundles turning upward and travelling through the outer wall of the ovary. The remainder of the pedicel bundle continues upwards into the columella as the placental bundle.

At the top of the locules the single placental bundle divides into four more or less horizontal arms which travel across the top of the ovary along the septal ridges. At the outer edges of the locules, each arm divides dichotomously, and the secondary branches divide again, the two tertiary branches travelling around the inner and outer margins of the locules respectively, and fuse with their equivalent adjacent branches to form a complete circumlocular ring. Ovule traces originate at or near the second dichotomies and travel downwards into the 1 or 2 ovules per locule.

At, or slightly below the level of the placental network, the antisepalous bundles form an inner and an outer branch while the antipetalous bundles form an inner branch only, the remainder of the antisepalous and antipetalous bundles fusing laterally to form an annulus which passes between the branches of the antisepalous bundles and outside the branch of the antipetalous bundle. The outer branch of the antisepalous bundle passes into the sepal as the median sepal trace, while the inner branch enters the adjacent stamen as the antisepalous stamen trace. Above the annulus, the single branch of the antipetalous bundle divides more or less simultaneously into 3 radially arranged traces. The outermost enters the petal as the petal trace, the central one enters the adjacent stamen as the antipetalous stamen trace, and the innermost forms the dorsal stylar trace, which fuses with the outermost tertiary branches of the placental network to form a compound dorsal stylar bundle. Lateral sepal traces are formed from the annulus. Lateral stylar traces are usually absent, but if present, they are very small and originate at the second dichotomy of the placental network, or from either the inner or outer tertiary branches.

G. micranthus subsp. *micranthus*: The flower of this plant conforms to the general pattern, except that no inner tertiary branch of the placental network is formed, and the outer branch is very weakly developed. Two ovules per locule are differentiated, but one aborts at an early stage and is not vascularised. The trace for the other ovule departs directly from the primary branch of the network at the first dichotomy. No lateral sepal traces are formed.

G. micranthus subsp. *ramosissimus*: The pattern of the vasculature is as for subsp. *micranthus*, but only one ovule per locule is differentiated.

G. mezianus: As for the general scheme. The petal trace is differentiated slightly below the annulus instead of above. Only one ovule per locule is differentiated but a very small stub of vascular tissue exists in the position that would have been occupied by a second ovule. Two lateral sepal traces per sepal were present in *Orchard 1810*, none in *Orchard 2583*. There are no lateral stylar traces.

G. teucrioides: This species conforms with the general pattern except that the inner tertiary branches of the placental network are very weakly developed. Two ovules per locule are formed, but one aborts at an early stage. However, the abortive ovule retains a very weak vascular trace. No lateral stylar or sepal traces are formed.

G. elatus: The vascular pattern of this species agrees exactly with the general pattern. Two ovules per locule are differentiated, but one aborts and is not vascularised. There are two lateral sepal traces, but no lateral stylar traces.

G. pycnostachyus: This species exactly conforms to the vascular pattern for the genus. Two ovules per

locule are differentiated, but one aborts and is no vascularised. Four lateral sepal traces per sepal are formed (none in *Eichler 20096*), but no lateral stylar traces (Fig. 14).

G. tetragynus: Three different patterns have been found in plants of this species.

Type 1: *(Orchard 2388)*. These flowers conform to the general pattern of floral vasculature in all respects. Only one ovule is differentiated per locule. No lateral sepal or lateral stylar traces are formed.

Type 2. (*Orchard 1824*). Flowers of this plant differ from the typical vascular plan only in the structure of the placental bundle. In the lower half of the ovary this bundle is the single solid cylinder normal for the genus. At about the midpoint of the ovary, four distinct lobes can be distinguished, and these spread until in the upper $\frac{1}{3}$-$\frac{1}{4}$ of the ovary, four distinct placental traces exist which diverge to form the primary branches of the placental network. Two ovules are differentiated in each locule but one aborts at an early stage. However, all eight ovules are vascularised, the traces to the abortive ovules being somewhat smaller. Two lateral sepal traces per sepal are formed, but no lateral stylar traces.

Type 3. (*Orchard 2394*). The flowers of this plant agree in their vascularisation with the general pattern except that they have very indistinct lateral stylar traces originating at about the position of the second dichotomy of the placental network. Two ovules per locule are differentiated and vascularised, but one aborts at an early stage. No lateral sepal traces are formed.

G. humilis: The vascular pattern conforms to that of the genus. Only one ovule is differentiated per locule and no lateral sepal or lateral stylar traces are found.

G. chinensis subsp. *verrucosus*: This species differs from the general pattern of vascularisation only in possessing very faint lateral stylar traces arising from about the position of the second dichotomy of the placental network. Two ovules per locule are differentiated and vascularised, but one aborts at an early stage. No lateral sepal traces are formed.

G. nodulosus: The vascular system of this species is modified because of the lack of the antipetalous whorl of stamens. This results in the inner branch of the antipetalous bundle having only two branches; the petal trace and the dorsal stylar trace. There is no residual vascular stub at the position of the missing stamen. The vascular pattern is otherwise as for the generalised generic scheme. Two ovules per locule are differentiated but one aborts at an early stage and is not vascularised. No lateral sepal traces are formed (Fig. 13).

G. cordiger: This species agrees with the general description, except for its lack of an inner tertiary branch of the placental network. The ovule traces depart directly from the primary branches. Two ovules per locule are differentiated, but one aborts at an early stage and is not vascularised. Two lateral sepal traces per sepal are formed.

Laurembergia: In the female flowers the vascular tissue enters from the pedicel as a single solid cylindrical bundle. Just below the locules eight radiating bundles are cut off, four antisepalous bundles alternating with four antipetalous bundles. The remaining vascular tissue continues upward into the columella as the placental bundle. The eight outer bundles travel upward through the ovary wall to the top of the locules, where the antisepalous bundles pass into the sepals as the median sepal traces while the antipetalous bundles travel into the styles as the dorsal stylar traces. At about the same level the placental trace divides to form four horizontal branches opposite the sepals. These branches travel outwards to near the outer margin of the locules where they divide dichotomously. The secondary branches pass around the outside of the locules, fusing with their adjacent equivalent branch and with the dorsal stylar trace to form a compound dorsal stylar bundle. In the absence of the circumlocular tertiary branches of the placental network, the ovular traces come from the primary branches. Only one ovule per locule is differentiated. There are no annulus, lateral sepal traces or lateral stylar traces.

The male flowers have a similar vascular pattern to the female flowers up to the level of the top of the locules. At this point the antipetalous bundles pass into the petals as the petal traces, while the antisepalous bundles divide to form an inner and an outer branch. The outer branch passes into the sepals as the median sepal trace while the inner branch forms the stamen trace. At the same level the placental trace forms four branches which pass into the styles as dorsal stylar traces. There are no annulus, lateral sepal traces or lateral stylar traces.

L. tetrandra: The male flowers agree exactly with the general description. Four ovules (one per locule) are differentiated in the female flower, but only one develops sufficiently to be vascularised. The

secondary branches of the placental network are only weakly developed; the dorsal stylar bundle is formed almost entirely from the dorsal stylar trace.

L. repens: This species agrees well with the general description. Occasionally the antisepalous bundle forms an inner branch which enters rudimentary staminodes. One ovule per locule is differentiated and vascularised. Only one ovule per flower forms a seed.

Proserpinaca: The vascular tissue enters the flower from the pedicel as a single solid cylindrical bundle. Below the locules six radiating bundles are cut off, three antisepalous bundles alternating with three "antipetalous" bundles. (Although there are no petals, the term antipetalous bundles is used here to describe the bundles homologous with the antipetalous bundles in the other genera, to facilitate comparison with these other genera). The remainder of the vascular tissue continues into the columella as three distinct placental bundles, arranged opposite the septa.

After traversing the outer wall of the ovary, the antisepalous bundles divide to form an inner and an outer branch, while the antipetalous bundles form an inner branch only. The remaining tissue in the six bundles fuses laterally to form an annulus. The outer branch of the antisepalous bundle enters the sepal as the median sepal trace, while the inner branch forms the (antisepalous) stamen trace. The branch of the antipetalous bundle passes into the style as the dorsal stylar trace. Before doing so it may form very weak branches to the positions that would have been occupied by the petal and antipetalous stamen.

Towards the top of the locules the three placental traces gradually diverge, passing outwards through the septa until near the outer limit of the locules. They then divide dichotomously, each of the secondary branches dividing again almost immediately. The outermost tertiary branch travels around the outer wall of the locule to fuse with its adjacent equivalent branch and with the dorsal stylar trace to form a compound dorsal stylar bundle. The inner tertiary branch travels around the inner wall of the locule and fuses with its adjacent equivalent branch, to complete the circumlocular trace. The ovule traces are formed from the inner portion of this ring. Lateral sepal traces arise from the annulus (Fig. 18).

P. pectinata: The flowers of this species match the general description well. No traces to the positions of the petals or antipetalous stamens are formed, nor are there any lateral stylar traces. Only a single ovule is differentiated in each locule. Two lateral sepal traces per sepal are formed.

P. palustris var. *crebra*: This species conforms well with the general description. A very weak petal trace is formed from the antipetalous bundle just below the annulus, but the trace does not enter the rudimentary petal. A similar weak trace is formed just above the annulus, to supply the antipetalous stamen. At the second dichotomy of the placental network, a small vertical trace is cut off which passes into the style as a lateral stylar trace. Two ovules per locule are differentiated, but one aborts at an early stage and is not vascularised. Four lateral sepal traces to each sepal are formed from the annulus.

P. platycarpa: This species agrees well with the general description. The placental traces are fused in the lower half of the ovary, but separate at about the midpoint and thence behave in the normal manner. The rudimentary petal and antipetalous stamen are both vascularised by weak traces arising from the antipetalous bundle, just above the annulus. The outer tertiary branch of the placental network is only weakly developed and no lateral stylar traces are formed. Two ovules per locule are differentiated, but one aborts at an early stage and is not vascularised. Two lateral sepal traces per sepal are cut off from the annulus.

Myriophyllum: The descriptions below are based on sections of male flowers of *M. propinquum* and *M. elatinoides*, and female flowers of *M. propinquum*.

Male flowers. Vascular tissue enters the flower as a single solid bundle. Almost immediately it divides to form a ring of eight bundles, four antisepalous bundles alternating with four antipetalous bundles. The antisepalous bundles pass undivided into the antisepalous stamens (the sepals are not vascularised). The antipetalous bundles each divide tangentially, the outer branch passing into the petals, the inner branch into the antipetalous stamens.

Female flowers. The vascular tissue enters the flower from the pedicel as a single solid bundle which passes upwards through the central axis to the top of the locules where it splits into eight radially arranged bundles, two opposite each locule. The two branches pass around the radial walls of the locule and reunite on the outer wall, where the combined bundle forms a single ovular trace which passes downwards into the ovule, and an upper dorsal stylar trace.

Interpretation

1. *Carpel Theory*. Under this theory the pattern of floral vasculature in, for example, *Haloragis,* can be interpreted as follows:

The flower contains four carpels fused to each other and to the lower parts of the perianth and staminal whorls. The placental bundle is the result of fusion of the ventral or intramarginal veins of the carpels; their true nature is shown by their division in the placental network at the top of the ovary. The dorsal bundle of the carpel is fused to the petal trace and antipetalous stamen trace up to the level of the annulus, where it diverges and enters the style. The traces from the placental network that fuse with the dorsal bundle are probably lateral carpel bundles. Their absence in *Haloragodendron,* or their conversion into lateral stylar bundles, or even the presence of extra strands forming lateral stylar bundles, is then understandable as the suppression or multiplication of lateral carpel bundles. The ovules are supplied from the inner branch of the circumlocular ring in *Haloragis* and this branch is interpreted as the fusion of the two intramarginal traces of the carpel.

The annulus, a constant and major feature of the floral vasculature of most genera, is probably the result of fusion of lateral traces from the sepals and petals which formerly supplied individual lateral sepal traces. Its absence in *Laurembergia* and *Myriophyllum,* where the sepals are very small, is therefore not surprising.

On this interpretation of the vasculature, considerable fusion of adjacent vascular strands has taken place during the evolution of the flower. The stamen traces have fused in all cases to the adjacent sepal and petal traces, and the dorsal carpel traces have also fused to the petal traces. With few exceptions, the eight ventral carpel traces have fused to form a single bundle, and often the adjacent lateral carpel traces have also fused to the placental bundle. A further fusion between parts of the sepal and petal traces has also occurred in the formation of lateral sepal traces via the annulus.

The structure of the male flower in *Myriophyllum* arises by complete suppression of the carpels, and that of the female flower by suppression of the perianth, stamens and dorsal carpel bundles. In *Laurembergia* reduction has not proceeded quite so far; the dorsal carpel bundle is still present in the female flower.

2. *Gonophyll Theory*. The floral vasculature of *Haloragis* can be interpreted readily according to Melville's (1962, 1963) theory of flower structure.

In Melville's view, the placental network represents the fusion of four dichotomously branching fertile branch systems, borne on four sterile tegophylls, now represented by the styles and dorsal stylar bundles. Each of the fertile branches bears a single (or rarely, two, with one abortive) ovule. The petals and sepals are each androphylls, with their attached anther. As in the carpel theory, the annulus must be interpreted as the fusion between branches from adjacent petal and sepal traces that formerly existed as distinct lateral sepal traces. The flower therefore consists of four gynophylls surrounded by eight androphylls.

The fusions necessary for this interpretation are mainly those of the four fertile female branches, and the further fusion between the gynotegophylls and the (petal) androphylls.

No difficulties exist in extending this interpretation to the flowers of *Gonocarpus, Glischrocaryon, Haloragodendron* and *Laurembergia.* In *Myriophyllum* it is necessary to propose the suppression of the dorsal tegophyll bundle in the gynophylls of the female flower, and the (sepal) androphylls in the male flower.

Summary of variation in Haloragaceae

The pattern of floral vasculature can be equally well explained by either the Carpel or Gonophyll theories, and Haloragaceae provides no new evidence that can be used to support or refute either theory. This evidence will probably have to come from more primitive families.

The floral vasculature of *Haloragis* and *Gonocarpus* is practically identical and provides very little new evidence that can be used to separate the genera. The only difference of note is the weaker development of the annulus in *Gonocarpus.*

In *Haloragodendron* the annulus is more strongly developed than in any other genus. This genus also differs from *Haloragis* and *Gonocarpus* in that the dorsal stylar trace receives no contribution from

the placental network; the branches normally involved either form lateral stylar traces or are absent. These differences provide additional evidence supporting the removal of *Haloragodendron* from *Haloragis*.

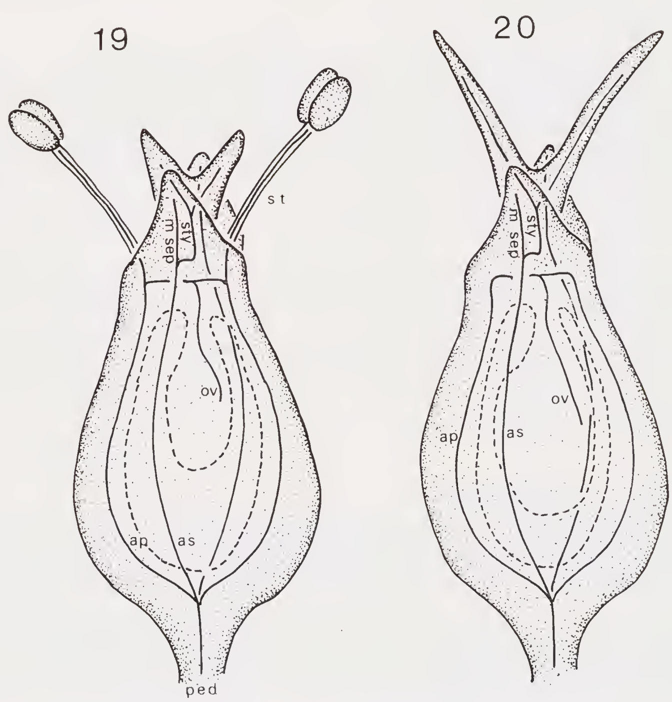
Glischrocaryon agrees closely in the pattern of its floral vasculature with that in *Haloragis* and *Gonocarpus*. The main differences are in the failure of the inner branch of the circumlocular ring to develop, and in the formation of lateral stylar traces from the first or second dichotomies of the placental network. The lateral stylar traces are additional to the branches of the network which fuse with the dorsal stylar trace.

Proserpinaca agrees with *Haloragis* and *Gonocarpus* in its floral vascular pattern. *Laurembergia* has a floral vasculature which reflects the reduction in size and complexity of its flowers. The female flowers are almost identical to the bisexual flowers of *Glischrocaryon*, but with the petal and stamen traces absent. The male flowers have a vascular pattern agreeing with that in the other genera, but with the placental network and antipetalous stamen traces absent.

In *Myriophyllum*, probably partly because of its reduced flowers and partly because of its aquatic habitat, there is a further reduction in floral vasculature. The male flowers are similar to those in *Laurembergia*, but the female flowers have completely lost the peripheral ring of bundles, and the placental network has been considerably reduced. The pattern of vascularisation is, however, still basically similar to that in the other genera.

The pattern of floral vasculature is thus useful in providing extra evidence for generic delimitation, although the overall pattern for the family is similar, and the differences between genera are, on the whole, small. While differences exist between species within a genus, they are not sufficiently constant for taxonomic purposes.

A survey has also been made of the floral vascular patterns of families previously suggested as possibly or probably closely related to Haloragaceae. It was hoped that the floral vasculature of these families might provide additional evidence for or against a close relationship. The results of this survey, based partly on new investigations, partly on literature reports, are discussed below.



Figs. 19, 20. Reconstruction, from serial sections, of flowers of *Gunnera macrophylla* (from *Hoogland 9551*). 19. Male flower. 20. Female flower. Abbreviations as for figs. 10-13.

Gunneraceae

Gunnera macrophylla: The single solid vascular bundle entering the base of the flower divides immediately to form four equally spaced strands which travel upwards through the wall of the ovary to the top of the locule. At this level, one pair of diametrically opposed bundles (the "antipetalous" bundles), each cut off an inner trace. These two traces fuse and pass downward into the single ovule as the ovular trace. The remainder of the two "antipetalous" bundles pass upwards into the stamens. One of the two antisepalous bundles cuts off an inner strand which passes more or less horizontally into the axis of the flower, just above the ovular traces, before turning upwards and dividing to pass into the base of the styles. The remainder of the antisepalous bundles enter the sepals as median sepal traces. In the female flowers, the pattern is identical with the exception that the antipetalous bundles are completely used up to form the ovular trace. There is no vascular stub in the position normally occupied by the stamens (Figs 19, 20).

Gunnera manicata: Described by Saunders (1939). This is apparently the only other member of the family to have been investigated. Saunders' species differed considerably from *G. macrophylla*. The branch from the antisepalous bundle is reported to enter the ovule, the styles being unvascularised. There was no mention of the branches from the "antipetalous" bundles, which in *G. macrophylla* form the ovular traces. In the female flowers vascular stubs are reported, going to the positions of the missing stamens. Saunders described petal traces derived from the antipetalous bundle in *G. petaloidea*.

The floral vasculature of *Gunnera* is so reduced as to be useless for comparison with Haloragaceae.

Trapaceae

Trapa bicornis: The vascular tissue enters the base of the ovary from the pedicel as a solid ring which soon splits into 8 separate strands in the ovary wall. The ovary is more or less square in section with a diagonal septum. The antisepalous strands a the ends of the septum each cut off an inner trace part of which enters the septum as placental traces, the remainder forming an inner antisepalous trace. The outer antisepalous trace soon diverges and passes into the sepal. The inner antisepalous traces pass into the two adjacent stamens as staminal traces. The remaining six original bundles link up to form a more or less complete annulus from which the petal traces and remaining two sepal (spine) traces and staminal traces diverge. The remaining annulus tissue passes upwards into the style as a ring of about 16 traces. The placental bundles fuse near the top of the ovary and send a branch into each ovule (Fig. 21).

Trapa, in its possession of an outer annulus formed from the petal and sepal traces, resembles both Haloragaceae and Onagraceae, among others. In its placental supply *Trapa* differs considerably from Haloragaceae, and agrees closely with the pattern in Onagraceae. Thus, in their floral vasculature, Trapaceae are more closely allied to Onagraceae than to Haloragaceae.

Onagraceae

The floral vasculature of this family was studied extensively by Bonner (1948) and Baehni & Bonner (1948, 1949). Their observations were confirmed by Eyde (1967) and by an investigation of *Fuchsia* in the present study. The vascular pattern is remarkably constant in its major features throughout the family and can be generalised as follows:

The vascular supply enters the flower from the pedicel as a single bundle which divides immediately to form eight peripheral strands, four opposite the sepals, four opposite the petals. The antisepalous strands are usually $\pm$ double, and as these travel upwards through the ovary wall, the inner strand sends traces through the septa to the ovules. At the top of the locules the antipetalous strands each cut off an inner trace, and these enter the style. At the point of insertion of the petals, the antisepalous and antipetalous strands cut off stamen traces on their adaxial faces, simultaneously forming lateral branches which link up to form an annulus. The remainder of the antisepalous strand becomes the median sepal trace, while the antipetalous strand divides tangentially, the innermost trace entering the petal, the outermost becoming lateral sepal traces. The glandular disc which surmounts the ovary in many species is vascularised by small traces from the eight peripheral strands.

The placentation of the ovules, via the septa from a peripheral bundle, is uniform throughout the family, even in those genera such as *Circaea* where there is only one ovule per locule. Onagraceae

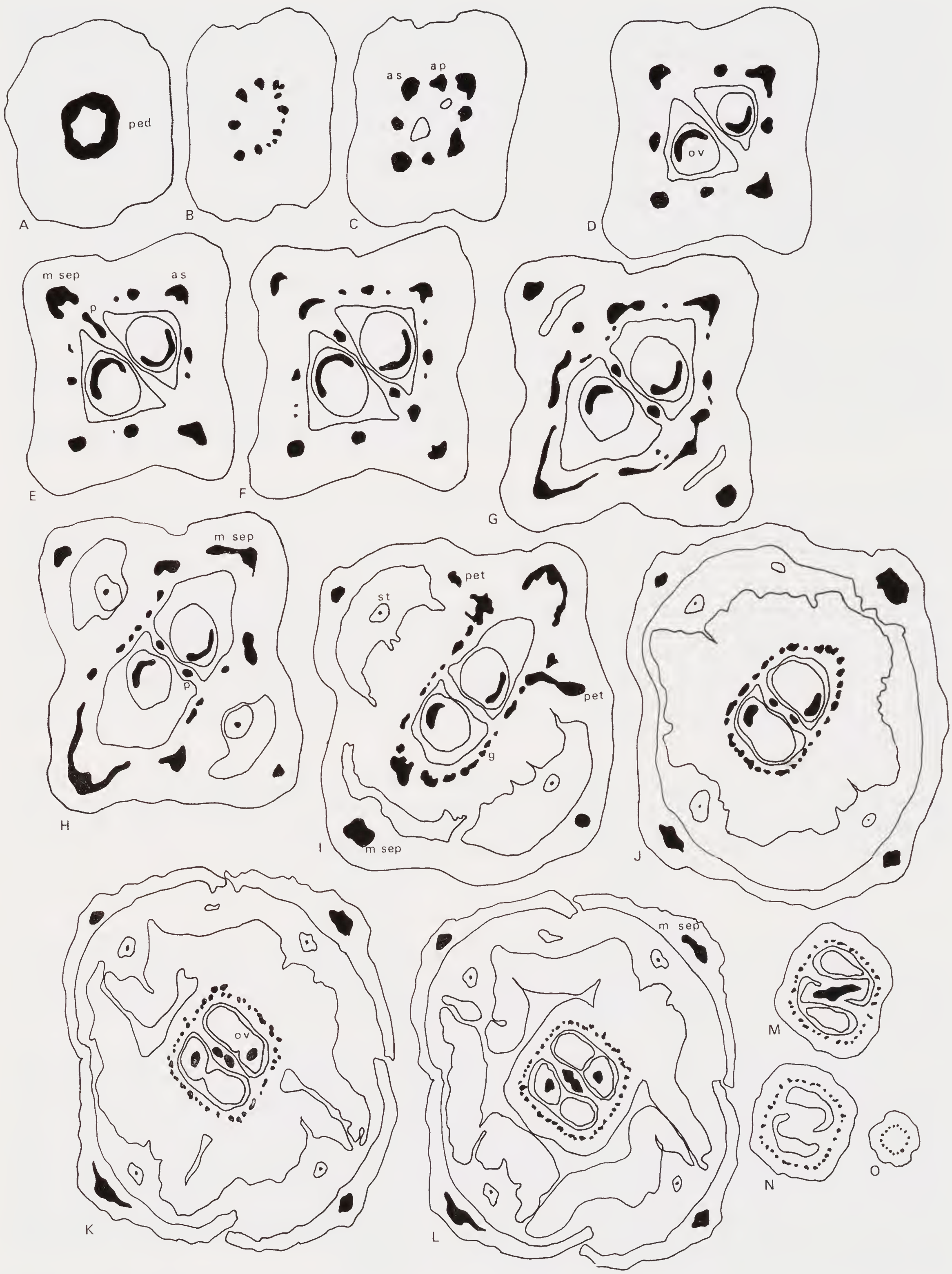


Fig. 21. Transverse sections of a flower of *Trapa bicornis* showing the arrangement of vascular tissue (from *Tun-Yee s.n.*, AD). Abbreviations as for figs. 10-13.

thus differ considerably from Haloragaceae in this respect, and also in the derivation of at least part of the lateral sepal supply from the antipetalous strand. The two families agree, however, in their possession of an annulus formed from the antipetalous and antisepalous strands.

Lythraceae

Bonner (1948) examined the floral vasculature of *Lythrum*, and material of *Heimia* and *Pemphis* was available in the present study. These genera all agree in their major vascular pattern and are described together below. Lythraceae differ from the other families under consideration in their superior ovary, but are included because of their generally accepted relationship to Onagraceae, and hence to Haloragaceae.

In Lythraceae the vascular tissue enters the flower as a ring of up to about 12 strands, antisepalous ones alternating with antipetalous ones. The antipetalous strands cut off inner traces at the base of the ovary and these travel upwards through the wall of the ovary into the style. At about the same level the antisepalous strands give rise to a large number of ovular traces which travel upwards through the central placenta to the ovules. Slightly above this level, all of the peripheral strands form stamen traces, before passing upwards through the floral tube into the sepals and petals. However, just before entering these organs, the antisepalous and antipetalous strands cut off weak lateral branches which link up to form an annulus. No lateral sepal traces are formed.

Bonner (1948) considered that the basic floral vascular pattern in Lythraceae was the same as that in Onagraceae, after allowance was made for the position of the ovary, and this judgment seems justified. The placentation pattern in Lythraceae does not support the suggestion of close affinity between that family and Haloragaceae, although both have the annulus structure formed by the peripheral strands.

Araliaceae

Material of *Tieghemopanax* and *Boerlagiodendron* was available during the present study, but the latter genus, because of its large flowers, has an extremely complicated vasculature and was discarded for comparative purposes. The pattern of vascular traces in *Tieghemopanax* is described below.

The vascular tissue enters the flower from the pedicel as a ring of 10 bundles. Just below the locules the inner ring of original bundles cut off eight outer bundles and in the resulting redistribution the flower has a peripheral ring of 10 bundles and 2 tranversely arranged placental bundles in the septum between the 2 locules. All 12 bundles pass upwards undivided until near the top of the locules where the placental bundles fuse with each other and with traces from the 8 adjacent peripheral bundles, the resulting single bundle then dividing in two so that a branch lies alongside each locule. Each of these branches then sends a trace to the single ovule in the adjacent locule, before dividing again and sending branches obliquely around the top of the locule. These ultimate branches link up to form dorsal stylar traces. The remaining tissue in the peripheral bundles passes upwards into the petals and stamens.

The pattern outlined above agrees well with that described by Philipson (1967) for *Hedera* and *Pseudopanax*, differing mainly in the failure of the dorsal bundle of the carpel in *Tieghemopanax* to link up with the dorsal stylar trace formed from the placental (= ventral) bundles. Philipson's account of *Hedera* agrees with that of Singh (1954), although different species were involved.

The dividing and reuniting of the placental bundles in the above genera very closely resembles that found in most Haloragaceae, but the other distinctive feature of the latter family, the annulus formed by the petal and sepal traces, is absent.

Apiaceae

The vasculature of the flowers (and fruits) of this family has been investigated by G. Jackson (1933) and Tseng (1967). Because the flowers are so small, the vascular arrangement is fairly simple, but is remarkably constant throughout the family.

The general pattern is for the vascular tissue to enter the flower from the pedicel and form a ring of about five strands which divide at the base of the ovary to form a peripheral ring of ten strands

and a placental strand. The placental strand is made up of four traces which are fused to varying degrees in the different genera. At the top of the ovary all four placental strands are usually distinct. The two strands opposite each locule then fuse with each other and with branches from the two adjacent "lateral strands" (from among the peripheral bundles), and the fusion bundle sends a trace down into the ovule. The remaining tissue divides and travels around the locule to where it fuses with a branch from the dorsal bundle to form the stylar trace. The peripheral bundles pass alternately into the petals and stamens.

The splitting and fusion of the placental bundles in Apiaceae bears some resemblance to the formation of the placental network in Haloragaceae, although the pattern in Apiaceae is less complicated. The contribution to the placental supply by the peripheral bundles and the lack of an outer annulus in Apiaceae are further points of dissimilarity to Haloragaceae.

Rhizophoraceae

The two species described below are apparently the first members of this family to be investigated from the point of view of floral vascular anatomy.

Rhizophora mucronata: Vascular tissue enters the flower from the pedicel as a ring of 35-40 discrete bundles. At the base of the locules these bundles arrange themselves into an inner and an outer ring, and towards the top of the locules the inner ring of bundles fuse laterally to form a "girdle" as in Combretaceae. This girdle gives rise to a placental strand at either end of the septum, and these strands divide longitudinally before joining together in the centre of the septum. The fused placental bundle then cuts off a trace to each of the four pendulous ovules. The remainder of the "girdle" passes upwards into the style as a ring of 10-15 traces, which may then divide further.

Of the outer ring of bundles, eight become larger by fusion with adjacent traces, forming antisepalous and antipetalous bundles, with some small intermediate traces remaining distinct. The antisepalous bundles divide tangentially to form an antisepalous stamen trace on the inside and a median sepal trace on the outside. The antipetalous bundles divide tangentially to form (from the inside moving outwards), an antipetalous stamen trace, a petal trace, and a bundle which divides further before passing into the two adjacent sepals as lateral sepal traces. Although the antisepalous and antipetalous bundles are described above as dividing, the fusion between the traces is usually minimal or even $\pm$ absent in many cases, and the stamen, petal and median sepal traces are effectively distinct from the base of the flower. The small intermediate traces that remained between the antisepalous and antipetalous bundles become lateral sepal traces. It is interesting to note that the petal trace appears to be double at the base of the petal, although it fuses higher up before giving rise to lateral traces (Fig. 22).

Bruguiera exaristata: Vascular tissue enters the base of the flower as a ring of about 18-20 discrete bundles, which by radial divisions form a ring of 9 antipetalous bundles alternating with groups of three smaller bundles. Of these three, the centre one becomes the antisepalous bundle. All of the traces move upwards in the ovary wall, until near the top of the locule the antipetalous and antisepalous bundles divide tangentially, and the inner branches so cut off fuse laterally to form a "girdle" around the locule. From the girdle three strands travel down the wall of the ovary to the base of the locule, where they fuse to form a hollow cylinder of placental tissue which ascends the placental column. At the point of attachment of the ovules, the placental trace divides into six horizontal branches, one of which enters each ovule. The remaining vascular tissue in the girdle travels upwards into the base of the style as about eight traces all except 3 of which soon peter out.

The antisepalous and antipetalous bundles divide tangentially as they enter the floral tube, and the inner branches form the stamen traces. The outer branch of the antisepalous bundle becomes the median sepal trace, but the outer branch of the antipetalous bundle divides tangentially again. The inner branch of this division forms the petal trace, while the outer branch divides twice more, sending two traces into each of the adjacent sepals as lateral sepal traces (Fig. 23).

The two distinctive features of the floral vasculature of Haloragaceae are absent in Rhizophoraceae, except in so far as the girdle may be homologous with the placental network. In addition, the contribution which the petal trace makes to the adjacent sepals in both *Rhizophora* and *Bruguiera* is unparalleled in Haloragaceae. A relationship between these two families is therefore not supported by floral vasculature.

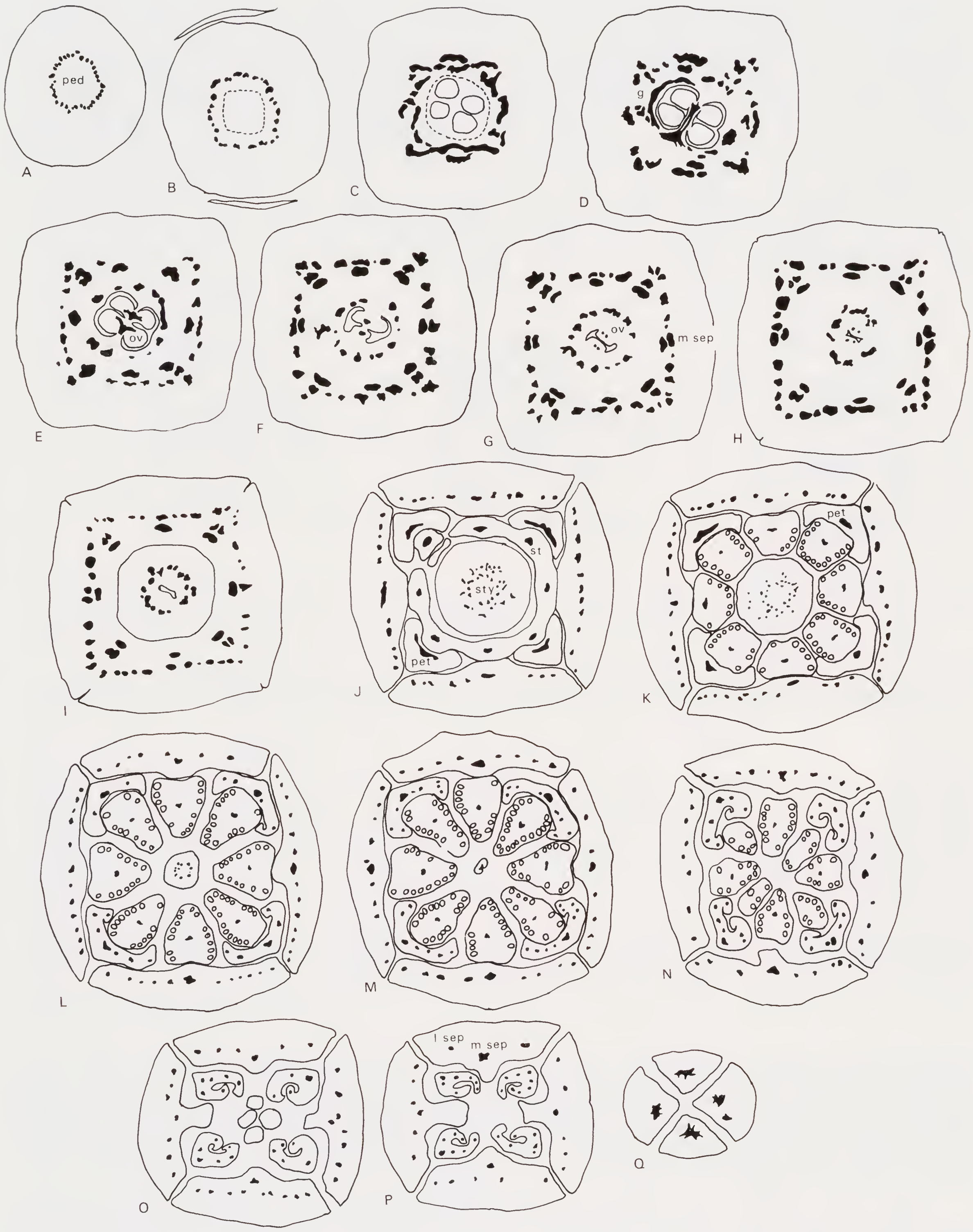


Fig. 22. Transverse sections of a flower of *Rhizophora mucronata* showing the arrangement of vascular tissue (from *Darbyshire 620*). Abbreviations as for figs. 10-13.

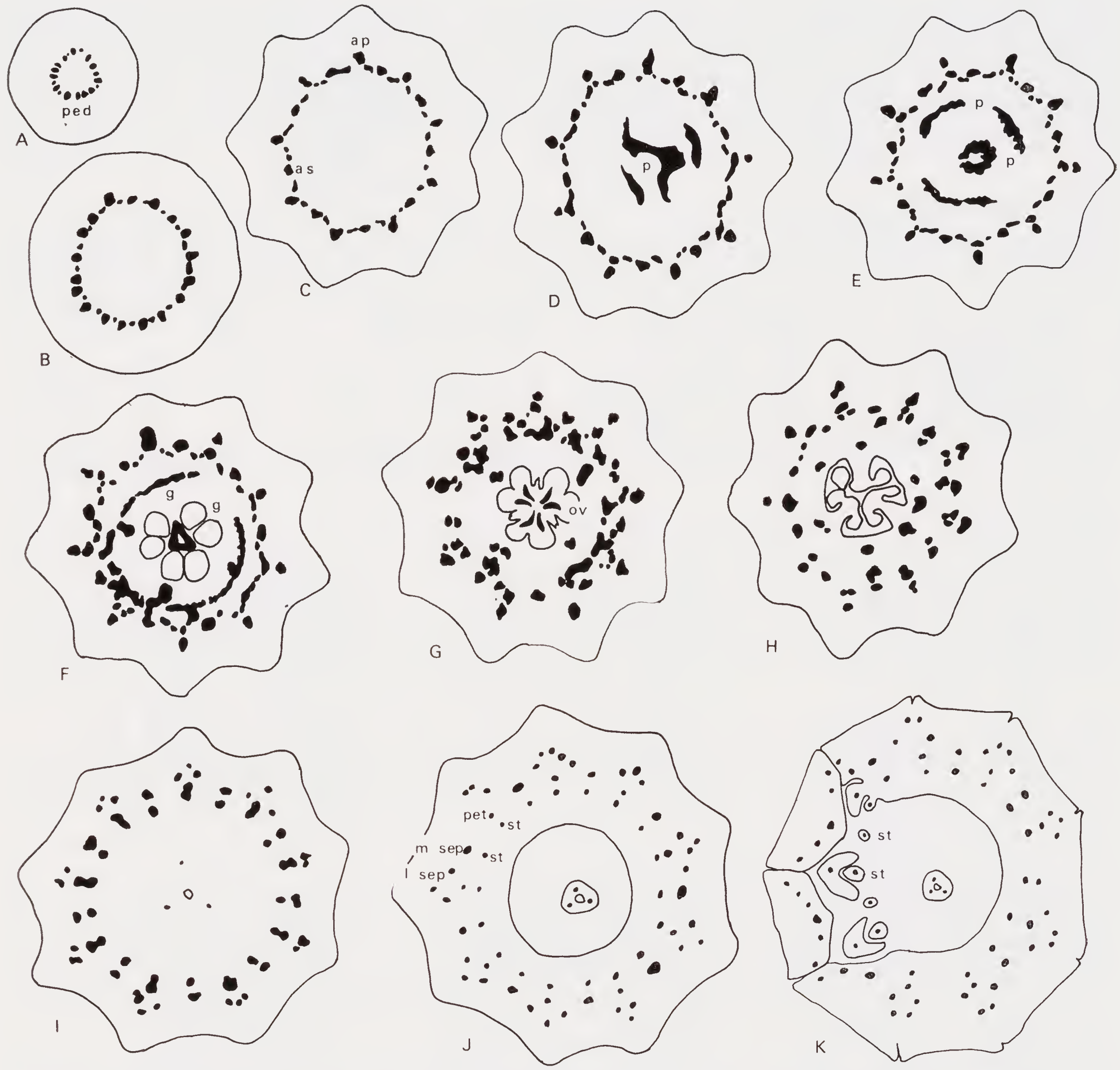


Fig. 23. Transverse sections of a flower of *Bruguiera exaristata* showing the arrangement of vascular tissue (from *Schodde 2735*). Abbreviations as for figs. 10-13.

Combretaceae

The floral vascular anatomy of members of this family has been studied recently by Tiagi (1969) and Venkateswarlu & Prakash Rao (1970). The former investigation involved seven species, five of which were also included among the twenty of the latter work. One species, *Lumnitzera littorea*, was examined in the present study. The results of all three investigations agree in showing an extremely uniform floral vascular pattern throughout the family.

With minor variations the vascular pattern is as follows. Four or five (in 4-merous or 5-merous flowers respectively) main vascular strands enter the base of the flower as antisepalous strands and travel upwards through the wall of the ovary to near the top of the single locule. Here they each cut off an inner trace, and these traces fuse laterally to form a ring. The "carpellary ring" (Tiagi, 1969) or "girdle" (Venkateswarlu & Prakash Rao, 1970), gives rise to a single trace to each ovule from its lower surface and (usually) an equal number of stylar traces from its upper surface. The remainder of the antisepalous strands pass upwards into the floral tube, where the petal strands are formed by fusion of lateral branches from adjacent antisepalous strands. At about the same level, the antisepalous stamen

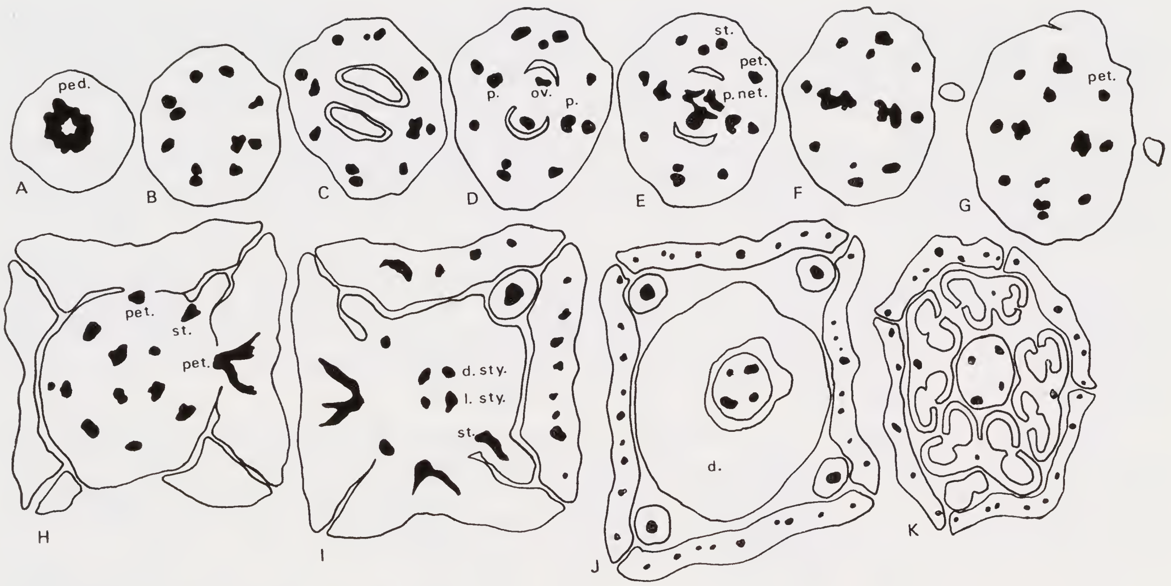


Fig. 24. Transverse sections of a flower of *Cornus alba* showing the arrangement of vascular tissue (from *Orchard 2589*). Abbreviations as for figs. 10-13.

traces and antipetalous stamen traces arise on the inner side of the antisepalous and petal traces respectively. The remaining parts of the antisepalous and petal bundles travel upwards into the sepals and petals, where each may branch further to form lateral traces within their respective organs.

There is no annulus as in Haloragaceae, but the "girdle" of Combretaceae may be homologous with the placental network of Haloragaceae modified because of the absence of a central placental strand.

Cornaceae

Cornus alba: A single solid bundle enters the flower from the pedicel and divides to form eight equally spaced bundles. One diametrically opposed pair opposite the septum immediately cut off small inner bundles (the placental bundles) which travel upwards through the ovary. All bundles in the ovary wall, with the exception of the placental traces, are more or less double at irregular intervals. At the top of the ovary the placental bundles send a trace inwards along the top of the septum, each trace dividing dichotomously. Each branch of the placental trace fuses with the opposite branch before entering the ovule. The remainder of the placental bundles travel upwards into the style. Of the outer ring of bundles, four enter the petals where they divide to form five to seven major petal traces, while the other four bundles, after cutting off very small traces to the vestigial sepals, enter the stamens. The two stamen bundles alternating with the stylar traces also form small traces to the style, which thus has four traces. The disc is unvascularised (Fig. 24).

The arrangement outlined above agrees with that found in other species of *Cornus* by Horne (1914), and Wilkinson (1944) and in *Thelycrania* by Philipson (1967). Both Philipson and Eyde (1967) examined the affinities of Cornaceae and satellite genera on the basis of, among other things, floral vascular anatomy. Eyde rejected a close affinity between Cornaceae *s. str.* and the families Caprifoliaceae, Hydrangeaceae, Styracaceae, Symplocaceae, Escalloniaceae, Diapensiaceae, Aquifoliaceae and Araliaceae, whereas Philipson, although mainly considering the position of *Griselinia*, appeared to favour a fairly close relationship between most of the above families.

In comparing Cornaceae with Haloragaceae, a comparison not made by Eyde or Philipson, it appears that the branching placental supply in e.g. *Cornus* noted particularly by Wilkinson (1944) bears some resemblance to the placental network in Haloragaceae. The major difference is that the placental bundle in Haloragaceae is axial whereas in *Cornus* the bundles are displaced to the ends of the septum. Cornaceae, however, lack the annulus formed in Haloragaceae by fusion of the sepal and petal bundles. This is not surprising as the main function of this structure appears to be the formation of lateral sepal traces, which are not required in the minute sepals common in Cornaceae.

Cornus and its allies are basically northern hemisphere plants whereas Haloragaceae is basically southern hemisphere in distribution. It therefore seemed logical to search among southern hemisphere Cornaceae for possible Haloragacean relationships. In this respect the anomalous genera *Griselinia* and *Corokia* which are often placed, at least tentatively, in Cornaceae are worth consideration.

Griselinia: Species of this genus have been studied by Horne (1914) and Philipson (1967). Although these accounts differ in some details (Horne described the ovular trace as being formed by fusion of three strands from the "girdle", while Philipson described it as always single), the basic pattern is the same in both accounts.

The vascular supply enters the flower from the pedicel as a ring of 10 bundles which travel upwards through the ovary wall to about the top of the locule. Here they each cut off an inner branch and these fuse laterally to form a "girdle". From the "girdle" one (or three?) traces descend into the single ovule, and three traces pass upwards into the styles. The remaining vascular tissue in the outer ring of bundles enters the perianth and stamens when these are present.

Both Horne and Philipson saw similarities between *Griselinia* and *Melanophora* (Cornaceae) but differed in their placement of the genus. Horne considered that *Griselinia* had floral vasculature compatible with inclusion in Cornaceae, whereas Philipson, in considering other anatomical features, thought that the genus occupied an isolated position between Escalloniaceae and Cornaceae-Araliaceae. Its possible similarity to Haloragaceae was not considered by either author.

The two outstanding features of floral vasculature in Haloragaceae, the outer annulus and the placental network, are not found in *Griselinia,* except in so far as the "girdle" can be considered homologous with the placental network. Even if this is correct, the extreme reduction of the ovary and perianth, and the well-developed tendency towards unisexual flowers in *Griselinia* make this genus much advanced over the more primitive genera of Haloragaceae. The possibility of *Griselinia* being ancestral to Haloragaceae is therefore unlikely, but it may still be related.

Corokia buddleoides: The vascular tissue of the pedicel consists of a ring of about 10 strands. At the base of the ovary they are rearranged to form a ring of 10 in the ovary wall (5 antisepalous strands alternating with 5 antipetalous strands) with 2 placental strands in a plane at right angles to the two locules. All 12 strands pass upwards through the ovary unbranched until near the level of attachment of the ovules (one, pendulous, per locule). Here each of the outer ring strands cuts off a trace on the innermost side, and these fuse with each other and with the placental strands to form a circumlocular annulus. Two branches from this annulus travel across the top of the septum, fork and send a branch of each into each ovule. The remainder of the annulus passes upwards into the style as an irregular ring of traces, all but two of which peter out in the "disc" region. The other two, in the plane of the locules, form the stylar traces. The remaining part of the outer ring strands do not form an annulus as in Haloragaceae, but instead the antipetalous strands pass undivided into the petals, where they subsequently cut off two lateral petal traces, while the antisepalous strands cut off an inner trace to the stamens before becoming undivided median sepal traces. Occasional tetramerous flowers occur, and the vasculature of these is identical with the 5-merous flowers until the point of departure of sepal, petal and stamen traces, where the extra strand is divided up between adjacent organs (Fig. 25).

This account, prepared from serial sections during the present study, agrees well with the accounts of Eyde (1966) and Horne (1914) except that the axial bundle observed by these authors was not present in the example described above. However, Eyde (p. 840) mentions that in rare cases the axial strand is absent in *C. cotoneaster*. Philipson's (1967) account of the vasculature of *C. cotoneaster* differs considerably from all the above accounts, perhaps because he considered only unilocular flowers. Consequently, his examples lacked the axial bundle and also one of the placental bundles. Eyde found that the stylar supply was derived directly from two of the peripheral bundles without any fusion with the placental supply, but Philipson shows (1967, fig. 10) the stylar supply fused with the placental ring. Philipson also shows the ovule trace coming from the ventral (or placental) bundle below the attachment of this bundle to the placental annulus. In Eyde's and in the present study the ovular trace(s) come from this annulus.

Philipson interpreted the vascular pattern of *Corokia* as indicating an affinity with Escalloniaceae. Eyde interpreted his findings as indicating an affinity with *Argophyllum* (Saxifragaceae *s.l.*). Horne retained *Corokia* in Cornaceae, but as an "outlying form of *Cornus* that . . . had an independent origin". The present study shows that the derivation of the placental supply has more similarity to that in *Cornus* than described in previous discussions, and a relationship between the two cannot be discounted on this basis.

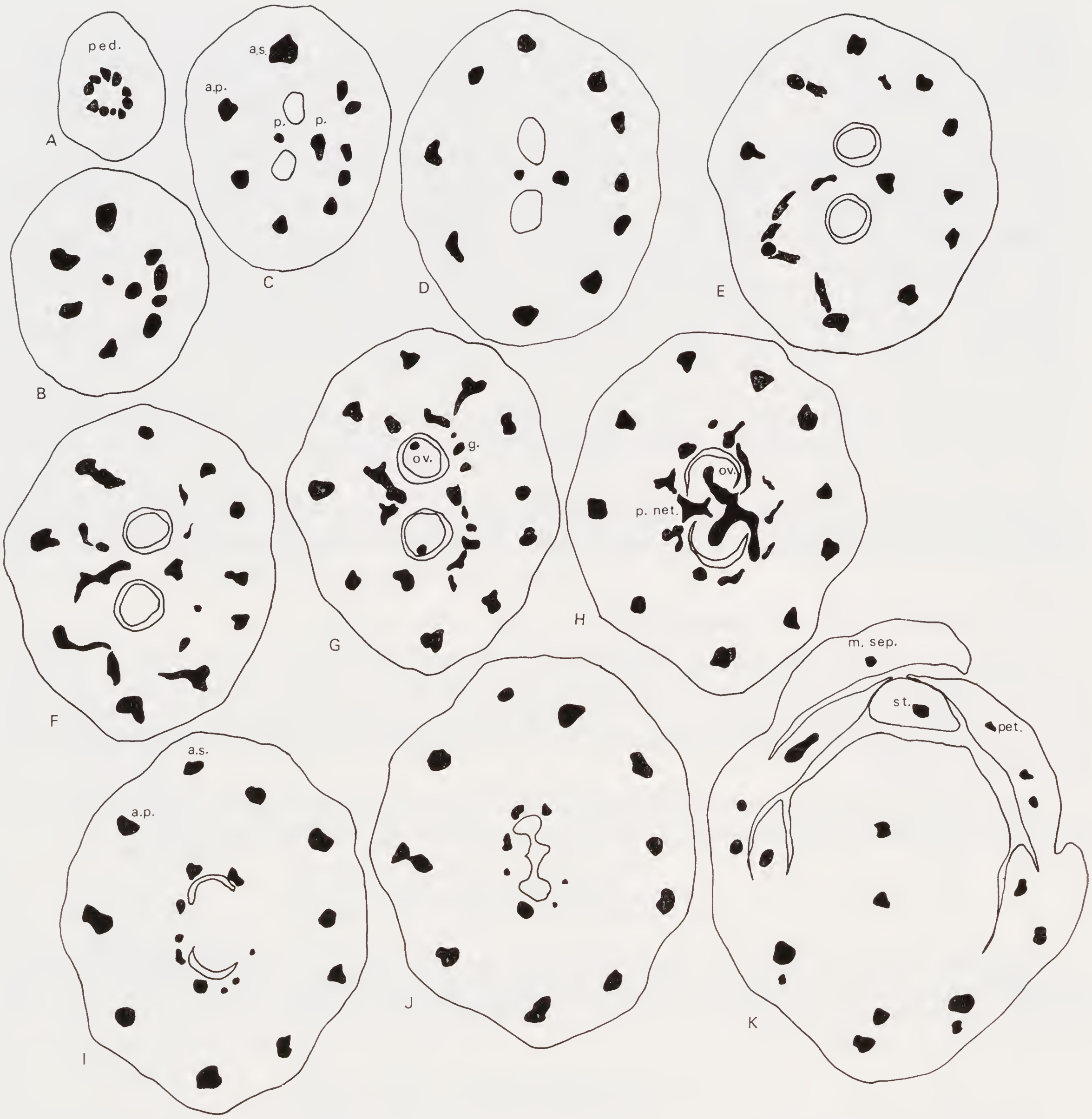


Fig. 25. Transverse sections of a flower of *Corokia buddleoides* showing the arrangement of vascular tissue (from *Sampson s.n.*, WELTU). Abbreviations as for figs. 10-13).

Similarly, the placental supply in *Corokia* bears a close resemblance to that in Haloragaceae although *Corokia* lacks the other distinctive feature (the outer annulus) of Haloragaceae. It seems appropriate to mention here that one of the other distinctive features of *Corokia,* the presence of abundant tannin in the flower, is also commonly found in Haloragaceae. The resemblance on other characters (trichomes, fruits and corolline ligules) is, however, not maintained. The evidence from the vascular anatomy and the tanniniferous cells of the flowers suggest that a possible affinity between *Corokia* and Haloragaceae is not ruled out, although its likelihood is reduced by other evidence.

Callitrichaceae

Callitriche stagnalis: The male flower consists of a single stamen in the axil of an upper leaf. It is vascularised by a single unbranched strand which arises from the solid axial stele. The female flower has a single bundle passing unbranched from the pedicel through the axis of the flower. At the top of

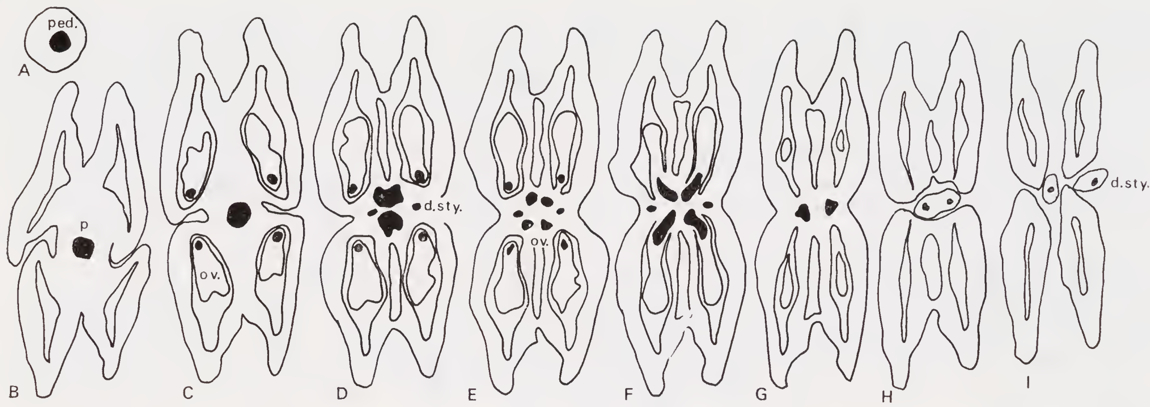


Fig. 26. Transverse sections of a female flower of *Callitriche stagnalis* showing the arrangement of vascular tissue (from *Orchard 2590*). Abbreviations as for figs. 10-13.

the locules it cuts off two lateral traces before dividing into four ovular traces, each of which serves a single ovule. Above the ovules, the two lateral traces converge somewhat before passing into the styles (Fig. 26).

Callitriche sonderi: As for *C. stagnalis*.

Apparently the only other report on the floral vascular anatomy of this family is that of Saunders (1939). No species were mentioned, but the description is basically the same as the present one. The single placental bundle in the lower part of the flower was not noted by Saunders, who described the four traces as traversing the whole flower. She also did not recognise the origin of the stylar traces in the placental bundle,

The extreme reduction of the flowers of this family is reflected in the reduction in floral vasculature. The vascular pattern is too simplified to be of use in comparison with Haloragaceae.

Aquifoliaceae

Apparently the only study of floral vasculature in this family is that of Copeland (1963). Unfortunately the species investigated bore only unisexual flowers with an extremely generalised and simplified vascular pattern which is of little use for comparison with Haloragaceae.

Datiscaceae

Davidson (1973) has compared the floral vasculature and morphology of this family with that of Haloragaceae, and found little resemblance between the two. There are no structures akin to the placental network or annulus of Haloragaceae in any of the Datiscaceae.

No accounts of the floral vasculature of members of the Celastraceae, Theligonaceae, Hippuridaceae or Ceratophyllaceae could be located, and no material was available for investigation.

SUMMARY

The two outstanding features of the floral vasculature of Haloragaceae are the placental network at the top of the ovary and the annulus formed by the peripheral bundles. The relationships of other groups to Haloragaceae can be assessed, in part, by the extent to which these other groups possess or lack a placental network and annulus. On this basis, the postulated relationship between Haloragaceae and Lythraceae, Onagraceae, Trapaceae, Rhizophoraceae, Combretaceae, Datiscaceae and *Griselina* is not supported, whereas the relationship between Haloragaceae and Araliaceae, Apiaceae and Cornaceae (including *Corokia*) is supported by this evidence. The floral vasculature of Gunneraceae and Callitrichaceae is too simplified to be of use in discussions of relationships.

WOOD ANATOMY

This aspect of the Haloragaceae has been almost completely neglected in the past, probably because the family has often been described as herbaceous. The structure of the xylem is dealt with in five lines by Metcalf and Chalk (1950).

To determine whether the secondary xylem of these plants could provide characters useful in phylogenetic considerations, a pilot survey of some aspects of wood anatomy was carried out during the present study. This survey included wood from the stems and roots of a number of species from the four main woody genera, *Haloragis, Gonocarpus, Haloragodendron* and *Glischrocaryon,* but is far from being complete. The species chosen were limited by availability, but an effort was made to cover the range of variation in each genus (see Table 2). The wood was either collected fresh and stored in F.A.A. until required, or taken from dried collections and soaked for several days in F.A.A. before use. The material was transferred to 70% ethanol 24 hours before sectioning on a sledge microtome at 10-30 μ. Transverse radial longitudinal and tangential longitudinal sections were cut from each sample, stained in safranin-fast green and mounted in XAM. In general, the wood was found to be ring-porous, with scanty or no wood parenchyma, exclusively bordered pits and both uniseriate and multiseriate, homogeneous and heterogeneous rays. Because of apparent differences between genera in the structure of their wood rays, this was the aspect studied in most detail. It was found that in all cases the structure of the wood rays tended to be more primitive in the root than in the stem of the same plant, and that the outer parts of the stem or root had a more primitive ray type than the inner parts (judged on the criteria proposed by Kribs, 1935). These findings agree with the general principles described by Barghoorn (1941). Descriptions of the wood ray structure in the various genera follow.

Table 2. List of vouchers for wood anatomy.
(All collections are housed in AD)

Name	Collection	Stem	Root
Haloragis			
H. exalata			
var. *exalata*	Orchard 2011, Moleside Ck., Victoria	+	
H. acutangula			
f. *tetraptera*	Orchard 2413, 1 km S. Moonta, S.A.	+	+
f. *turbinata*	Orchard 2414, 1 km S. Moonta, S.A.	+	+
H. aspera	Orchard 1843, Siccus River, S.A.	+	+
H. uncatipila	Orchard 900, 24 km N. Tennant Ck., N.T.	+	+
Haloragodendron			
H. monospermum	Orchard 2389, Corang River, N.S.W.	+	
	Orchard 2391, Corang River, N.S.W.		+
H. racemosum	Orchard 1285, Boyatup Hill, W.A.	+	
Glischrocaryon			
G. behrii	Orchard 1805, 5½ km S. Monarta Sth, S.A.	+	+
	Orchard 1808, 9 km S.E. Finnis, S.A.	+	+
	Orchard 2148, 13 km W. Kimba, S.A.	+	+
G. aureum			
var. *angustifolium*	Orchard 1120, Loc. 251, Shire of Esperance, W.A.		+
G. flavescens	Orchard 1227, Loc. 1105, Shire of Esperance, W.A.	+	+
	Orchard 2172, Yandinga Gorge, S.A.		+
Gonocarpus			
G. elatus	Orchard 1813, Black Hill, S.A.	+	+
G. pycnostachyus	Orchard 1079, 12 km S.E. Condingup Peak, W.A.	+	+
G. tetragynus	Orchard 1803, 5½ km S. Monarto Sth., S.A.		+
	Orchard 2388, 6½ km S. Coffs Harbour, N.S.W.	+	
G. mezianus	Orchard 1868, Upper Waterfall Gully, S.A.	+	+
G. teucrioides	Orchard 2347, Springbrook, Qld.	+	
G. oreophilus	Orchard 2382, Whian Whian Forest, N.S.W.	+	

Haloragis

(1) Stem: In the inner parts the rays are usually all uniseriate and homogeneous, composed of vertically elongated cells 2-5 (-10) times as high as long. This is the type omitted in Kribs's classification. but described by Barghoorn (1941). In the outer parts of the stem the rays are a mixture of uniseriate homogeneous and bi- or multi-seriate heterogeneous types (Kribs's Heterogeneous Type II B). Very few

cells, even of the multiseriate rays, are markedly radially elongated; most are ± isodiametric, with those of the uniseriate rays and at the margins of the multiseriate rays vertically elongated by up to five times their radial length.

(2) Root: The rays are a mixture of uniseriate homogeneous and multi-seriate heterogeneous types (Kribs's Heterogeneous Type I). The uniseriate rays are composed of vertically elongated cells about 2-3 times as high as their radial length, while the multiseriate rays have isodiametric or slightly radially elongated cells in the multiseriate part, with a jacket and high uniseriate wings of cells similar to those of the uniseriate rays.

Haloragodendron

(1) Stem: The rays are a mixture of homogeneous uniseriate and multiseriate types, composed entirely of vertically elongated cells 2-3 times as high as their radial length. This arrangement does not fit into Kribs's classification, but as most of the multiseriate rays are only 2-3 (-5) cells wide with very long uniseriate tails, it probably comes closest to the supplementary type described by Barghoorn (1941).

(2) Root: (Based on *H. monospermum* only). The rays consist of a mixture of uniseriate homogeneous and multiseriate heterogeneous types (Kribs's Heterogeneous Type I). The uniseriate rays are relatively scarce and composed of vertically elongated cells 2-3 times as high as their radial length. The multiseriate rays are composed of radially elongated cells with a jacket and high uniseriate tails of cells similar to those of the uniseriate rays.

Glischrocaryon

(1) Stem: There is very little secondary thickening in the stems of this genus. The rays are scarce and uniseriate, consisting of vertically elongated cells 2-3 times as high as their radial length. They thus comply with Barghoorn's supplementary type.

(2) Root: The rays are nearly all multiseriate, with rare uniseriates, and composed of radially elongated cells 2-3 times as long as high, with a jacket of isodiametric or slightly vertically elongated cells (Kribs's Heterogeneous Type II B or almost Homogeneous Type II). The multiseriate rays more or less lack uniseriate wings.

Gonocarpus

(1) Stem: The rays are numerous to scanty, and all homogeneous uniseriate, composed of vertically elongated cells 3-5 times as high as their radial length. This corresponds to Barghoorn's supplementary type.

(2) Root: The rays are usually scanty and all uni- or bi-seriate, composed of isodiametric or vertically elongated cells, as in the stems.

SUMMARY

Based on the phylogenetic series proposed by Kribs (1935) and Barghoorn (1941), *Haloragis* has the most primitive wood ray structure of the four genera studied. In the stems of *Haloragodendron* the multiseriate rays are reduced in width compared with *Haloragis* and have greatly lengthened uniseriate tails. In the roots of *Haloragodendron* the uniseriates are almost eliminated and the multiseriates again have high tails. In *Glischrocaryon* and *Gonocarpus* the multiseriate rays have been entirely eliminated in the stems, but are retained in the roots (uniseriates are rare in the root of *Glischrocaryon*). These latter two genera would therefore be considered the most advanced in their wood ray structure. The frequency with which Barghoorn's supplementary type of ray (uniseriates only, with vertically elongated cells) occurs is interesting in view of his statement that this type is found mainly in shrubby or semi-shrubby plants in which secondary activity is being reduced.

As pointed out by I. W. Bailey (1957), in using features of wood anatomy for phylogenetic considerations, the most significant correlations are the negative ones: a taxon with primitive features cannot be derived directly from one with advanced features. Therefore if Haloragaceae *s. str.* are monophyletic (and this seems to be the case from other evidence), then they cannot be derived directly from any group which has a consistently more advanced wood ray structure than that of the most primitive genus of Haloragaceae, namely *Haloragis*.

A summary made from Metcalf & Chalk (1950) of information on wood ray structure of woody families previously considered to be related to Haloragaceae is given below. Unfortunately, it has not been possible to check this information against actual material.

Onagraceae: The rays usually consist of a mixture of uniseriate and multiseriate types composed of isodiametric or vertically elongated cells. The wood in this family is also noted for scanty parenchyma and interxylary phloem.

Lythraceae: The rays are exclusively uniseriate or up to 2-3 cells wide, homogeneous (Kribs's Type III) or heterogeneous (Kribs's Types II B & III). Wood parenchyma ranges from scanty to abundant, and intraxylary phloem is known to occur in many genera.

Rhizophoraceae: Uniseriate rays are rare to absent in some genera, common in others and then often composed of vertically elongated cells. Multiseriate rays are common, composed of isodiametric or procumbent cells with a jacket of ± vertically elongated cells. Wood parenchyma is typically scanty.

Combretaceae: The rays are either exclusively uniseriate or mixed with multiseriate types, conforming to Kribs's Homogeneous Types I and III, or heterogeneous and composed largely of isodiametric or vertically elongated cells. Both inter- and intra-xylary phloem are common in the family, and wood parenchyma is typically abundant.

Celastraceae: The rays are either exclusively or predominantly uniseriate, homogeneous with conspicuous intercellular spaces or else a mixture of uniseriate (often rare) and multiseriate heterogeneous types conforming to Kribs's Types I, II A and III. Wood parenchyma is usually absent or sparse.

Aquifoliaceae: The rays consist of uniseriate types formed of high upright cells, mixed with heterogeneous multiseriate kinds, conforming to Kribs's Heterogeneous Type I. Wood parenchyma is ± abundant.

Cornaceae: The rays conform to Kribs's Heterogeneous Type I. The uniseriate rays are composed entirely of upright cells, and the multiseriate rays have a jacket of isodiametric or upright cells. Parenchyma is common to scanty. Patel (1973) has described the wood anatomy of several New Zealand species of *Griselinia* and *Corokia*. He found in *Griselinia* heterogeneous Type II rays, rarely Type I, with scanty paratracheal or rarely vasicentric, diffuse and diffuse-in-aggregates parenchyma. In *Corokia* the rays were also heterogeneous Type II, sometimes also Type I, and the parenchyma was sparse, scanty paratracheal and diffuse.

Araliaceae: Uniseriate rays are usually rare to absent, composed of isodiametric or upright cells. The multiseriate rays are usually heterogeneous (Kribs's Type II A, II B), rarely homogeneous (Kribs's Type I), with a thin jacket of isodiametric to upright cells. Wood parenchyma is often extremely sparse.

Apiaceae: Uniseriate rays are usually rare to absent, the multiseriate slightly heterogeneous (Kribs's Type II B) or sometimes almost homogeneous. Wood parenchyma is scanty to vasicentric, and the development of an extra-fascicular cambial ring has been reported in the stems of some species.

Datiscaceae: The rays are either mainly multiseriate or a mixture of uniseriate and multiseriate, heterogeneous, composed of square to upright cells, with a jacket of upright cells around the multiseriates (probably Kribs's Heterogeneous Type II B). Wood parenchyma is scanty or plentiful.

Of the families discussed above Lythraceae, Combretaceae, Apiaceae and most of Celastraceae are unlikely to represent the progenitors of Haloragaceae, judged only on the structure of their wood rays, and Araliaceae are also probably too advanced in this respect to be considered further. The presence of inter- or intra-xylary phloem in Onagraceae, Lythraceae and Combretaceae, but its absence in Haloragaceae makes the probability of the latter family having been derived from any of the former families unlikely.

The remaining families, Cornaceae, Rhizophoraceae, Datiscaceae and Aquifoliaceae have no major dissimilarities with Haloragaceae on the points of wood anatomy discussed above, and the possibility of their relationship to that family is not precluded by this evidence.

EMBRYOLOGY

Most of the embryological data cited below are adapted from the summaries given by Davis (1966), with very little reference to the original papers. However, any new evidence appearing in the literature after this date has been incorporated. A major exception to this rule is the case of Haloragaceae, in which Davis included the genera *Myriophyllum, Laurembergia, Gunnera* and *Hippuris*, with the result that the embryology of this family appears extremely variable. Because of this confusion, each genus of

Haloragaceae is described separately below, with reference to the relevant literature for each. The genera *Gunnera, Trapa, Hippuris* and *Callitriche,* which have sometimes been included in the family are similarly treated.

Haloragis

(*H. colensoi, H. asperrima* — Kapil (1962), Kapil & Bala Bawa (1968).

Anther wall formation is apparently of the Monocotyledonous type (from the figures of Kapil & Bala Bawa), and the mature wall consists of epidermis, endothecium, 2 middle layers and a glandular tapetum. Microspore cytokinesis is simultaneous and the pollen is shed at the 3-celled stage. The ovule is anatropous, bitegmal and crassinucellar, with porogamous fertilisation. The development of the embryo-sac is of the Polygonum type, the endosperm is *ab initio* Cellular and embryogeny conforms to the Myriophyllum-variation of the Caryophyllad type. A conspicuous 2-celled suspensor haustorium is derived from the basal cell.

Laurembergia

(*L. javanica* — Bley (1925), *L. brevipes* — Bala Bawa (1969a), *L. hirsuta* — Nagaraj & Nijalingappa (1974)).

The anther wall consists of epidermis, endothecium, single middle layer and uninucleate, glandular tapetum, and development follows the Monocotyledonous type. Microspore cytokinesis is simultaneous, and the pollen grains are shed at the 3-celled stage. The ovule is anatropous, bitegmal and crassinucellar, with porogamous fertilisation. The development of the embryo sac is of the Polygonum type, the endosperm is Nuclear and embryogeny conforms to the Myriophyllum-variation of the Caryophyllad type. A prominent 2-celled suspensor haustorium is derived from the basal cell.

Myriophyllum

(*M. alterniflorum* — Stolt (1928), Soueges (1940); *M. intermedium* — Nagaraj & Nijalingappa (1967), Bala Bawa (1969b)).

Judging by the figures of Nagaraj & Nijalingappa and Bala Bawa, anther wall formation is probably of the Dicotyledonous type, with two or three middle layers (single middle layer — Bala Bawa) and a glandular tapetum. Microspore cytokinesis is simultaneous and the pollen grains are shed at the 3-celled stage. The ovules are anatropous, bitegmic and crassinucellar, and fertilisation is porogamous. The development of the embryo sac is of the Polygonum type, ('Normal type' — Stolt), the endosperm is *ab initio* Cellular (*M. intermedium*) or Nuclear (*M. alterniflorum* Stolt) and embryogeny conforms to the Myriophyllum-variation of the Caryophyllad type. A large 2-celled suspensor haustorium is derived from the basal cell.

Gunnera

(Schnegg (1902); *G. chilensis* — Kellermann (1881), Modilewski (1908); *G. macrophylla* — Samuels (1912); *G. insignis* — Virkki (1962)).

Anther wall formation and microspore cytokinesis are not described; the pollen is shed at the 2-celled stage. The ovule is bitegmic, anatropous and crassinucellar, with porogamous fertilisation. The development of the embryo sac is of the Peperomia type and the endosperm is *ab initio* Cellular. Details of embryogeny do not appear in the literature. No suspensor haustorium is formed from the basal cell.

Hippuris

(*H. vulgaris* — Unger (1849), Juel (1910, 1911), Soueges (1922)).

Details of anther wall and microspore development have not been recorded; the pollen is shed at the 3-celled stage. The ovules are anatropous, unitegmic and tenuinucellar, with fertilisation occurring by a lateral penetration of the embryo sac by the pollentube. The development of the embryo sac follows the Polygonum type, the endosperm is *ab initio* Cellular and embryogeny conforms to the Onagrad type. A long haustorial suspensor is formed.

Callitriche

(Joergensen (1923, 1925), *C. vernalis* — Soueges (1952)).

Anther wall development is not recorded; the tapetum is glandular, microspore cytokinesis is simultaneous and the pollen is shed at the 3-celled stage. The ovule is anatropous, unitegmic and tenui-

nucellar, and fertilisation is porogamous. Embryo sac development follows the Polygonum type, endosperm is of the *ab initio* Cellular type with a large micropylar haustorium and a smaller hooked chalazal haustorium, and embryogeny conforms with the Onagrad type. The suspensor is very long and consists of up to 4 rows of cells.

Trapa

(*T. natans* — Gibelli & Ferero (1891a, 1891b, 1895); Ishikawa (1918), Tison (1919); *T. bispinosa* — Ghosh (1954), Ram (1956)).

Anther wall formation in the species studied is probably of the Dicotyledonous type, judging by the figure of Ram, and consists of epidermis, endothecium, 2-3 middle layers and a glandular tapetum (amoeboid rarely in *T. bispinosa*). Microspore cytokinesis is in centripetal succession and pollen is shed at the 2-celled stage, although pollen germination *in situ* is common. The ovule is anatropous, bitegmic and crassinucellar, fertilisation occurring via a nucellar beak protruding between the integuments. The development of the embryo sac is of the Polygonum type, the endosperm is absent and embryogeny is of the Solanad type. *Trapa* is noted for its two extremely unequal cotyledons, and for its curious convoluted suspensor haustorium, resembling that of conifers.

For comparative purposes, embryological details of other families are set out in Table 3.

SUMMARY

Haloragis, Laurembergia and *Myriophyllum* form a remarkably uniform group on embryological evidence. The only points of difference, the Dicotyledonous type of anther wall formation in *Myriophyllum* vs. the probably Monocotyledonous type in the other genera, and some variation in endosperm formation, are more than outweighed by their agreement in all other respects, including the rare Myriophyllum-variant of the Caryophyllad type of embryogeny.

Trapa differs from the *Haloragis* group in its successive microspore cytokinesis, 2-celled pollen, well-developed nucellar beak, complete lack of endosperm, Solanad type of embryogeny, and conifer-like suspensor haustorium. These differences outweigh the few similarities and along with the differences between *Trapa* and Onagraceae summarised by Ram (1956) seem to justify the recognition of the monogeneric family Trapaceae. The connection between *Trapa* and Lythraceae suggested by Miki (1959) is not strongly supported by the embryological evidence.

Gunnera differs from the *Haloragis* group in its 2-celled pollen and Peperomia type embryo sac. Although little is known of embryogeny in this genus, the figure in Modilewski (1908) certainly does not follow the Myriophyllum-variant of the Caryophyllad type. Bala Bawa (1969a) considered that the embryological data combined with some morphological features, justified the separation of *Gunnera* from Haloragaceae as Gunneraceae. More detailed studie on the development of the anther wall, microspores and embryo are needed.

Bala Bawa (1969a) summarised the embryological and morphological evidence pointing towards exclusion of *Hippuris* from the *Haloragis* group of genera. The former genus deviates from the latter group in its unitegmic, tenuinucellar ovule, unusual type of fertilisation, Onagrad type of embryogeny and long uniseriate haustorial (?) suspensor. Soueges (1922) suggested that embryologically this genus approaches Scrophulariaceae.

Callitriche in most modern systems is removed from close proximity to Haloragaceae and placed in the Sympetalae, often near Labiatae and Verbenaceae. This position, as pointed out by Joergensen (1923), is supported by the embryological evidence. *Callitriche* differs from the *Haloragis* group in its unitegmic, tenuinucellar ovule, the development of large terminal endosperm haustoria, and Onagrad type of embryogeny.

Although *Haloragis* and its allies are usually placed in or adjacent to the family Onagraceae, this close relationship is not reflected in their embryology. Onagraceae differ from Haloragaceae *s. str.* in their 2-celled pollen grains, Oenothera type of embryo sac, and Onagrad type of embryogeny. Lythraceae agree with Onagraceae in most respects but come slightly closer to Haloragaceae by their development of a Polygonum type embryo sac.

Table 3. Summary of embryological data from selected families.

	Anther wall type	Tapetum	Microspore cytokinesis	Stage of pollen at shedding	Ovule orientation
Cornaceae (Chopra & Kaur, 1965)	—	—	simultaneous	2-celled	anatropous
Lythraceae	Dicotyledonous	glandular	simultaneous	2-celled	anatropous
Onagraceae	—	—	simultaneous	2-celled	anatropous
Combretaceae	Basic	glandular	simultaneous	2-3-celled	anatropous
Rhizophoraceae	—	—	—	—	anatropous to hemianatropous
Apiaceae	Dicotyledonous	glandular	simultaneous	3-celled	anatropous
Araliaceae	—	glandular	simultaneous	(2-) 3-celled	anatropous
Celastraceae	—	glandular	simultaneous	2-celled	anatropous
Aquifoliaceae	—	glandular (?)	—	2-celled	anatropous
Datiscaceae	—	—	—	2-celled (Davidson, 1973)	anatropous
Theligonaceae (Kapil & Rao, 1966)	—	glandular	simultaneous	3-celled	amphitropous or campylotropous
Ceratophyllaceae	—	amoeboid	successive	2-celled	orthotropous

(— indicates no information available)

Integuments	Nucellus	Embryo sac devel.	Endosperm formation	Embryogeny	Suspensor haustorium
1	crassinucellar	Polygonum/ Fritillaria type	ab initio cellular	—	—
2	crassinucellar	Polygonum type	Nuclear	Onagrad type	absent
2	crassinucellar	Oenothera type	Nuclear	Onagrad type	absent
2	crassinucellar	Polygonum or Penaea type	Nuclear	Asterad type	absent
2	crassinucellar	Polygonum type	Nuclear with terminal haustoria	—	massive suspensor
1	tenuinucellar	Polygonum type (rarely, Allium, Drusa or Penaea)	Nuclear	Solanad type	absent
1	crassinucellar	Polygonum type	Nuclear	—	—
2	crassi- or tenuinucellar	Polygonum type	Nuclear	Solanad or Caryophyllad type	absent
1	crassinucellar (rarely tenui-)	Polygonum type	ab initio cellular	Carophyllad type	—
2	crassinucellar	Allium type	Nuclear	Onagrad type	—
1	crassi- or tenuinucellar	Polygonum type	Nuclear	Chenopodiad type	—
1	crassinucellar	Polygonum type	ab initio cellular	Asterad type	No suspensor

Cornaceae, the family nominated by Schindler (1904, 1905) as showing, after Onagraceae, the closest resemblance to Haloragaceae, are relatively poorly known embryologically. Nothing is described of anther wall development or embryogeny. In their known features, Cornaceae differ from the *Haloragis* group in their 2-celled pollen and single integument. However, the remaining points of resemblance are so generalised that no reliable conclusion concerning relationship can be drawn.

Araliaceae and Apiaceae are almost identical embryologically and differ from the *Haloragis* group in their unitegmic, tenuinucellar (Apiaceae only) ovules and Solanad type of embryogeny. As such, these families show more dissimilarity to *Haloragis* than do Combretaceae, which differ only in their Asterad type of embryogeny. The related family Rhizophoraceae is too poorly known to be adequately compared, but the few known details (with the exception of the massive suspensor) show no discrepancies with the *Haloragis* group.

Celastraceae and Aquifoliaceae have very similar details of embryology, and show the greatest similarity to the *Haloragis* group of all the families considered. Aquifoliaceae have unitegmic ovules but with this exception, at least some members of each family match the *Haloragis* group in all essential respects. They are the only two families of those considered which share with the *Haloragis* group the Caryophyllad type of embryogeny, although of a different variant.

Ceratophyllaceae differ from the *Haloragis* group in nearly all details, rendering a close relationship extremely unlikely. Similarly Datiscaceae, although poorly known, differ from the *Haloragis* group in two major respects, their Allium type embryo sac and Onagrad type embryogeny, and are thus unlikely to be closely related. Theligonaceae are also unlikely to be closely allied to the *Haloragis* group, differing in their campylotropous, unitegimc, tenuinucellar ovules and Chenopodiad type of embryogeny. On this sort of evidence Kapil & Rao (1966) suggested that Theligonaceae were closely associated with Phytolaccaceae and Amaranthaceae.

POLLEN MORPHOLOGY

The pollen morphology of many species of Haloragaceae has been studied by Praglowski (1970). Of necessity, he based his work ~~on~~ the taxonomic system of Schindler (1905) with the result that no distinction was made between *Haloragis s. str.* and *Gonocarpus*. In addition, the names used by Praglowski were taken directly from herbarium sheets in most cases, and several of these were in error.

Many of the voucher specimens, or duplicates of them, have been re-examined in the present study, and Praglowski's results for the genera *Haloragis, Haloragodendron, Glischrocaryon* and *Gonocarpus* have been re-tabulated, with the nomenclature updated, in Tables 4-7. Voucher collections marked with an asterisk (*) have not been re-examined, neither in the original nor in duplicate, and their determinations must be considered to be tentative.

On the basis of pollen morphology, Praglowski concluded:

1. That the species *Haloragis monosperma, H. racemosa* and *H. lucasii* more closely resemble '*Loudonia*' *(Glischrocaryon)* in their pollen characteristics than they do the other species of *Haloragis,* or indeed, any other members of Haloragaceae. Praglowski believed (mistakenly) that the flower morphology and mode of pollination of these three species supported their transfer to *Glischrocaryon.* As described elsewhere, these three species, with the addition of two others not considered by Praglowski, constitute the new genus *Haloragodendron*, which, while it resembles the genus *Glischrocaryon* in some respects, is quite different in others. Praglowski's evidence provides confirmation of the distinctiveness of this new genus, originally recognised on macro-morphological grounds.

2. That the exclusion of *Gunnera* from Haloragaceae is strongly supported by the evidence from pollen morphology. This exclusion is also supported by differences in embryology and macro-morphology. Although stating that the pollen morphology of *Gunnera* "does not exhibit the slightest resemblance nor affinity with the pollen morphology of the Haloragoideae" Praglowski apparently still saw Gunneraceae as related to, although more advanced than Haloragaceae by his agreement with the system proposed by Takhtajan (1969). In the present study, a greater separation of these families is proposed.

3. That the pollen morphology is very uniform between the species within each genus, and there is a close similarity between the pollen of *Haloragis* (incl. *Gonocarpus*), *Laurembergia, Proserpinaca* and

Myriophyllum. Glischrocaryon and *Haloragodendron* are distinct from the above five genera on pollen morphological grounds.

4. That there is little observable difference between the pollen of *Gonocarpus* ("*Haloragis* sect. Monanthus") and *Haloragis* ("*Haloragis* sect. Pleianthus") except that the pollen of the former generally has a larger number of apertures. Praglowski considered that the difference in pollen between *H. brownii* and the other species of *Haloragis* supported the separation of that species in the genus *Meionectes.*

The rearrangement of the species in Tables 4-7 above does not alter any of Praglowski's conclusions to a marked degree. The only observable differences between *Haloragis s. str.* and *Gonocarpus,* once misidentifications have been eliminated, are a tendency to more apertures in *Gonocarpus* (often as many as 6 or 7, never less than 4) as compared with *Haloragis* (occasionally as few as 3, never more than 5), and, on average, thicker exine in the grains of *Gonocarpus*, particularly at the aperture margins. While the presence of pori is relatively rare in the pollen grains of these species, there is a pronounced clustering of this character in the species of the *H. erecta-H. exalata* group, and in *H. acutangula-H. aspera-H. glauca.* Pori are much less common in the grains of *Gonocarpus* species, and seem to be randomly distributed.

Erdtman (1966), on the basis of the few descriptions of pollen then available for Haloragaceae, discussed the possible relationships of the family. He considered that on the palynological evidence, the removal of *Trapa* to Trapaceae ['Hydrocaryaceae'] was justified. This genus differs from Haloragaceae *s. str.* in having larger grains (50-80 μ) and three well-defined, more or less folded meridional crests. Erdtman saw some similarities between the pollen of this family and that of some members of Onagraceae.

The pollen of Callitrichaceae was described by Erdtman (1966) as $\pm$ spheroidal or ovoid with no distinct apertures or provided with 2-3 (-4) irregular, thin, $\pm$ aperturate areas. The sexine is usually slightly thicker than the nexine, and more or less reticulate. Erdtman considered that this combination of characters was "slightly reminiscent of the grains in *Fraxinus excelsior*" but quite different from those in Boraginaceae, Euphorbiaceae, Haloragaceae and *Gratiola* (Scrophulariaceae), postulated relatives of Callitrichaceae on various other types of evidence.

According to Erdtman (1966) the pollen of Onagraceae ('Oenotheraceae') differs from that of all other families, although that of, for example, *Fuchsia* has a faint resemblance to the grains of Haloragaceae and that of other genera recalls perhaps Hydrocaryaceae (= Trapaceae), Proteaceae and Rubiaceae. The genera of Cornaceae are heterogeneous in their pollen morphology, but from the scanty descriptions provided for *Griselinia* and *Corokia* in Erdtman (1966) and Cranwell (1942) the resemblance between the pollen of these two genera and Haloragaceae is slight.

Erdtman's (1966) remarks and descriptions indicate some similarities of the pollen of the families Apiaceae, Araliaceae, Celastraceae, Combretaceae, Lythraceae and Rhizophoraceae, with that of Haloragaceae, although none of the resemblances is strong. On the other hand, the pollen of the families Aquifoliaceae, Ceratophyllaceae, Datiscaceae, Hippuridaceae and Theligonaceae has little or no affinity with that of Haloragaceae.

SUMMARY

The pollen morphological evidence tends, on the whole, to support those hypotheses which assign Haloragaceae to an isolated position, rather than those suggesting a relationship with any one or more families. *Haloragis, Gonocarpus, Myriophyllum, Proserpinaca* and *Laurembergia* have fairly uniform pollen characteristics, while *Gunnera* deviates somewhat from this pattern, with perhaps some links through *Glischrocaryon* and *Haloragodendron.* The pollen grains with the greatest similarity to those of Haloragaceae are found in the Betulaceae and Ulmaceae, two families usually not considered to have affinities with this group. Neither the inclusion of *Trapa, Hippuris* and *Callitriche* in Haloragaceae, nor the close relationship of this family with Ceratophyllaceae, Theligonaceae, Datiscaceae or Aquifoliaceae, is supported by the evidence from pollen morphology. A slight similarity exists between the pollen of Haloragaceae and some Onagraceae (e.g. *Fuchsia*), and the pollen grains of some members of Apiaceae, Araliaceae, Celastraceae, Combretaceae, Cornaceae, Lythraceae and Rhizophoraceae have some features in common with those of Haloragaceae.

Table 4. Pollen morphology of *Haloragis* (amended and rearranged

	Polarity	Amb.	NPC	Shape & P/E index	Type	Size in μ
H. exalata F. v. M.						
*NSW, Nepean River (K)	Para occ. iso	Gonio	443 (543)	SO 70	4	24 × 34
H. exalata var. *laevis* (Schindl.) Orch.						
*Austr., NSW. Boorman s.n. Det. Schindl. (W)	Iso or para	Gonio	444 443	O 73	4	24 × 33
H. stricta R. Br. ex Benth.						
Austr., R. Br. s.n., Det. Schindl. (P)	Iso occ. para	Gonio-interm	443 (543)	SO 77	4	17 × 22
H. erecta (Murr.) Oken subsp. *erecta*						
N. Zealand, L. B. Moore s.n. (CHR87922)	Para occ. iso	Gonio	443 (543) (343)	SO 87	4	27 × 31
*N. Zealand, S. Berggren s.n. (S)	Para or iso	Interm	543 544 (643) (644) (443) (444)	SO 80	5	28 × 35
N. Zealand, L. B. Moore s.n. (K)	Iso	Peritr.	443 (543)	SO 83	4	25 × 30
H. erecta subsp. *cartilaginea* (Cheesem.) Orch.						
N. Zealand, Baylis s.n. (CHR18171)	Para	Gonio-interm	443 (543)	SO 81	4	27 × 33
H. masafuerana Skotts.						
Masafuera, Skottsb. 1216 Det. Skottsberg (S)	Para	Gonio	443 543 (444) (544)	SO 82	4, 5	26 × 32
H. masatierrana Skotts.						
Masatierra, Skottsb. 304 Det. Skottsberg (UPS)	Para or iso	Interm	444 (443)	SO 78	4	27 × 35
*J. Fernandez Isl. Collector? (S) [? = *H. masafuerana*]	Para or iso	Interm-peritr	443 (444) (543) (544)	SO 87	4	26 × 30
H. prostrata Forst. & Forst. f.						
N. Caledonia, H. S. McKee 5234 (K)	Para occ. iso	Gonio	443 (444) (343) (344)	O 74	4	23 × 32
H. serra Brongn.						
Austr., NSW, C. Stuart s.n. (K)	Para	Gonio-interm	444 (443)	SO 80	4	26 × 32
*Austr., NSW, J. H. Maiden s.n. HLB 910 199-1402 (L)	Para occ. iso	Interm	443 (444)	SO 83	4	24 × 29
H. odontocarpa F. v. M.						
*Austr. NSW. Wanaaring, Glenfield Veter. Res. Station 39/1738 (NSW)	Para	Gonio-interm	443	O 73	4	22 × 30
W. Austr. T. E. H. Aplin 2367 (PERTH)	Para	Gonio	443 543	SO 78	4, 5	23 × 29
*S. Austr., Hill 101 (W)	Para	Gonio	443 543	SO 77	4, 5	33 × 43
H. gossei F. v. M.						
S. Austr., T. R. N. Lothian 1706 (AD)	Para	Interm-peritr	443 (543)	SO 79	4	27 × 34
W. Austr., N. T. Burbidge 1052 (PERTH)	Para	Interm	443 (543)	SO 82	4	26 × 31

from Praglowski (1970, Table 2)). (* Voucher specimens not re-examined).

Colpi (μ)	Pori (μ)	Exine thickness (μ): In polar view: Mesocolpia	Exine thickness (μ): In polar view: Aperture margins	Exine thickness (μ): At poles	Tectal details in LO: Puncta	Tectal details in LO: Supra-tectal processes	Special morphological characteristics
4 × 1.5		2	4 - 5	2, 1.5	+	—	Ap. prot., ap. shape occ. irregular
3 × 1	3 × 2 2 × 2	2	3 - 4	2, 1.5 2, 2	+	—	Ap. not prot.
2 × 0.5		2	2 - 2.5	2, 2	—	—	Grains comp. small
4 × 1 3 × 1.5		2	3 - 4	2, 1.5	+	—	
3 × 1	4 × 3 3 × 2	2	2.5 - 3	1.5, 1	+	+	Ap. not prot., ap. shape occ. irregular
4 × 0.5 3 × 0.5		2	2.5 - 3	2, 2	+ +	—	Dist. isopolar, ap. not prot.
4 × 1.5		2	3.5	2, 1.5	+	—	Ap. not prot., exine comp. thin
2.5 × 1	(3 × 2)	2	3.5	2, 1	+	—	Ap. not prot.
(5 × 2)	4 × 3 4 × 2.5	1.5 - 2	2.5, 3	1.5, 1 1.5, 1.5	+	+	Ap. not prot.
4 × 1	(3 × 2)	2	3	2, 1.5	+	+	Ap. not prot., exine comp. thin
4 × 1.5	(3.5 × 2.5)	1.5 - 2	3 - 4	2, 1.5	+	—	
(5 × 2) (3 × 1)	4 × 2.5 2 × 1.5	2 - 2.5	3 - 4	2, 1.5	—	—	
5 × 2	(3.5 × 2)	2	3	2, 1.5	—	—	Ap. not prot.
4 × 1		1.5 - 2	2.5 - 3.5	2, 1.5	+	—	Ap. not prot.
6 × 1 3 × 1		2 - 2.5	3 - 4	2, 1.5	+	—	Ap. not prot.
5 × 1		2.5 - 3	4 - 5	2.5 - 1.5	+	—	
6 × 2 4 × 1		2	3.5	1.5, 1	+ +	+	Exine comp. thin, ap. not prot.
4 × 1 3 × 0.5		2 - 2.5	3 - 4	1.5, 1	+	+	Ap. not prot.

	Polarity	Amb	NPC	Shape & P/E index	Type	Size in μ
H. trigonocarpa F. v. M.						
W. Austr., C. A. Gardner 7543 (PERTH)	Para	Gonio	443 543	O 72	4, 5	18 × 25
W. Austr., A. S. George 693 (PERTH)	Para	Gonio	543 443	SO 82	5, 4	24 × 30
W. Austr., C. A. Gardner s.n. (PERTH)	Para occ. iso	Gonio-interm	443 (543)	SO 81	4	22 × 27
H. acutangula F. v. M. f. *acutangula*						
S. Austr., A. Orchard 1871 (AD)	Para	Gonio-interm	443	SO 77	4	26 × 34
S. Austr., C. R. Alcock C17B (AD)	Para occ. iso	Gonio	443 543 (444) (544)	SO 76	4, 5	25 × 33
H. aspera Lindl.						
S. Austr., A. Orchard 310 (AD)	Iso or para	Gonio	543 (643)	SO 78	5	28 × 26
S. Austr., A. Orchard 316 (AD)	Iso or para	Gonio	443 543 444 544	SO 78	4, 5	25 × 32
S. Austr., A. Orchard 308 (AD)	Para or iso	Gonio	543 544 (443) (444) (643) (644)	SO 80	5	28 × 35
H. glauca Lindl. f. *glauca*						
Austr. NSW, T. & J. Whaite 1745 (K)	Para or iso	Peritr-interm	(443) (444)	SO 86	4	21 × 26
H. foliosa Benth.						
*W. Austr., N. T. Burbidge s.n. (PERTH)	Para	Gonio	443 (543)	SO 83	4	25 × 35
H. aculeolata Benth.						
W. Austr., A. Morrison 11246 (K)	Para or iso	Peritr	443 (543)	O 69	4	22 × 32
H. scoparia Fenzl						
W. Austr., Drummond s.n. (W)	Para or iso	Interm	343	SO 78	3	26 × 33
H. heterophylla Brongn.						
Queensland, Hubbard 4092 (W)	Para occ. iso	Gonio	543 (643) (443)	O 73	5	24 × 33
H. digyna Labill.						
S.W. Austr., Maxwell s.n. (MEL)	Para occ. iso	Gonio	443 (543)	O 73	4	24 × 33
H. tenuifolia Benth.						
W. Austr., Diels & Pritzel 189 (PERTH) [= Diels 1811?]	Iso occ. para	Interm	443 (543) (444) (544)	SO 88	4, 2	29 × 33
W. Austr., Koch s.n. (W)	Iso occ. para	Interm	443 444 (543) (544)	SO 80	4, 2	24 × 30
H. brownii (Hook. f.) Schindl.						
Austr. Victoria. A. C. Beauglehole 5861 (L)	Iso	Interm	444	SO 76	4, 2	25 × 33

Colpi (μ)	Pori (μ)	Exine thickness (μ) In polar view Mesocolpia	Aperture margins	At poles	Tectal details in LO Puncta	Supra-tectal processes	Special morphological characteristics
2.5 × 0.5		2	2 - 3	1.5, 1	—	—	Grains comp. small
4 × 1		2	3 - 4	1.5, 1	+	—	Ap. not prot.
3 × 1.5		2	2.5	1.5, 1	+	—	Ap. not prot.
4 × 1 3 × 0.5		1.5 - 2	2 - 3	1.5, 1	+	—	Ap. not prot.
5 × 2 4 × 1	(4 × 3)	2 - 2.5	3 - 4	2.5, 1.5	+	—	S. concave mesocolpia
5 × 0.5 4 × 0.5		2 - 2.5	4 - 5	2, 1.5	+	—	Anomotreme and loxocolpate grains occur
4 × 1.5	4 ×3 3 × 3	2.5 - 3	3 - 4	1, 1	+ +	—	Two pollen types (porate, exine comp. thin; colpate, exine comp. thick)
5 × 1.5	4.5 × 3.5	1.5	3	1.5, 1	+	—	Exine comp. thin, 7-8 treme and anomotreme grains occ. occur
5 × 1 4 × 1	(2 × 1.5	1.5 - 2	2 - 2.5	2, 1.5	+	+	Ap. not prot.
4 × 1		2	3 - 4	2, 1.5	—	—	Ap. not prot.
5 × 1 3 × 1		2	2.5 - 3	2, 2 2, 1.5	+	—	Ap. not prot.
5 × 1 4 × 0.5		2	3 - 4.5	2, 2 2, 1.5	+	—	3-treme only
5 × 0.5 4 × 0.5		2 - 2.5	3 - 5	2.5, 1.5	—	—	
5 × 1 4 × 1		2 - 2.5	4 - 5	2, 1.5	—	—	
6 × 2.5 5 × 1	(5 × 3) (4 × 3)	1.5 - 2	3	2, 2 1.5, 1.5	+	+	Exine comp. compact, convex mesocolpia, ap. as in subsectio Meionectes
3 × 0.5	5 × 3	1.5 - 2	2.5 - 3	2, 2 1,5 1.5	+	+	Exine comp. compact, convex mesocolpia, ap. as in subsectio Meionectes
3 × 2 2 × 2		2	2	2, 2	+	+	Exine comp. compact, convex mesocolpia, ap. simple, lacking endoapertural part, dist. iso.

Table 5. Pollen morphology of *Haloragodendron*

	Polarity	Amb	NPC		Shape & P/E index	Type	Size in μ
H. racemosum (Labill.) Orch.							
W. Austr., R. D. Royce 6225 (PERTH)	Iso	Peritr.	543	643	SO 86	5, 6, 1	19 x 22
S.W. Austr., T. E. H. Aplin 2620 (PERTH)	Iso	Peritr.	543	643	SO 89	5, 6, 1	17 x 19
H. monospermum (F. v. M.) Orch.							
Austr., NSW, W. Baeuerlen s.n. (W)	Iso	Peritr.	643	(543)	O SPH 91	6, 1	20 x 22
Austr., NSW, F. v. Mueller s.n. 903 364-188 (L)	Iso	Peritr.	543	643	SO 81	5, 6, 1	18 x 22
H. lucasii (Maid. & Betche) Orch.							
Austr., W. Blakely s.n. (S)	Iso	Peritr.	643 (443)	(543)	SO-O 75	6, 1	20 x 26

(amended and rearranged from Praglowski (1970, Table 2))

Colpi (μ)	Pori (μ)	Exine thickness (μ) In polar view: Mesocolpia	Exine thickness (μ) In polar view: Aperture margins	Exine thickness (μ) At poles	Tectal details in LO: Puncta	Tectal details in LO: Supra-tectal processes	Special morphological characteristics
7 x 1.5		2	1	2, 2	+	+	Exine compact, grains tenuimarginate, of Loudonia-type
7 x 1 6 x 1		2	1	2, 2	+ +	+	Exine compact, grains tenuimarginate, of Loudonia-type
5 x 1 4 x 1		2	1	2, 2	+	—	Exine compact, apocolpia flattened, grains tenuimarginate, of Loudonia-type
6 x 1.5 5 x 1		2	1	2, 2	+	—	Exine compact, apocolpia flattened, grains tenuimarginate, of Loudonia-type
4 x 1 2.5 x 0.5		2.5 - 3	1.5	2.5, 2.5	—	—	Exine compact, grains tenuimarginate, of Loudonia-type, comp. large

Table 6. Pollen morphology of *Glischrocaryon* (amended and rearranged

	NPC	Shape & P/E Index	Size in μ
G. flavescens (Drumm. ex Hook.) Orchard			
W. Aust., G. E. Brockway s.n. (PERTH)	643 (543)	SO-OBL-SPH 88	17 × 20
W. Aust., E. Pritzel s.n. (W)	543 (443)	SO-OBL-SPH 88	17 × 20
G. aureum (Lindl.) Orchard			
*W. Aust., A. Morrison s.n. (US)	643 (543)	SO 82	23 × 28
*W. Aust., Koch s.n. (W)	643	SO 87	22 × 25
G. behrii (Schldl.) Orchard			
S. Aust., C. R. Alcock C36A (AD)	643 (543)	SO 84	22 × 26
*S. Aust., C. M. Eardley s.n. (S)	543 (643)	OBL-SPH 90	18 × 20
*Vict., Anon. (W136560)	543	SPH 100	16 × 16

from Praglowski (1970, Table 1)). (* Voucher specimens not re-examined).

Colpi (μ)	Puncta in L.O.	Special morphological characteristics
10 × 1	—	
8 × 0.5	—	
15 × 0.5	+	Comp. thick exine (3μ), grains s. gonio.
16 × 0.5	+ +	
11 × 1	+ +	Comp. thick exine (3μ)
6 × 0.5	+	
5 × 0.5	—	

Table 7. Pollen morphology of *Gonocarpus* (amended and rearranged

	Polarity	Amb	NPC	Shape & P/E index	Type	Size in μ
G. teucrioides DC.						
*Tasmania, H. E. Comber 1721 (K)	Para	Interm	543 643	SO 78	5, 6	31 × 40
G. montanus (Hook. f.) Orch.						
Tasmania, Burbidge 3287 (K)	Para	Interm	643 (543) (743) (843)	SO 77	6	30 × 39
Tasmania, Hook. f. s.n. (UPS)	Para or iso	Gonio	643	O 64	6, 7	21 × 33
G. salsoloides Rchbch. ex Sprengel NSW, Sieber 249 (W)	Para occ. iso	Gonio	443 543 (544) (444)	SO 78	4, 5, 7	24 × 31
*Austr. NSW, Major Vickary s.n. (K)	Para occ. iso	Gonio	443 543	SO 77	4, 5	27 × 35
G. serpyllifolius Hook. f.						
*Austr. NSW, Kaspiew 88	Para occ. iso	Gonio	643 (743) (543)	SO 76	6	26 × 34
G. aggregatus (Buchanan) Orch.						
N. Zealand, H. E. Connor s.n. (CHR)	Para occ. iso	Peritr	543 443 (544) (444)	SO 84	5, 4	21 × 25
*N. Zealand, King 549 (K)	Para	Interm-peritr	443	SO 79	4	23 × 29
N. Zealand, Colenso s.n. (K)	Para occ. iso	Interm-peritr	443	SO 82	4	25 × 30
G. halconensis (Merr.) Orch.						
Philippines, Lobb 448 (K)	Iso occ. para	Peritr-interm	444 (443)	SO 79	4	23 × 29
*N. Guinea, R. Pullen 5035 (K) [? = *G. sanguineus*]	Iso or para	Peritr-interm	443 (444)	SO 79	4	22 × 28
Papua, E. G. Crutwell 1123 (K)	Para occ. iso	Interm	443 543	SO 79	4, 5	23 × 29
*N. Guinea, L. J. Brass 11672 (K)	Para	Gonio	443 (543)	SO 81	4	22 × 27
*Papua, E. G. Crutwell 1441 (K)	Para	Gonio-interm	443 543	SO 77	4, 5, 7	23 × 30
G. tetragynus Labill.						
*S. Austr., I. Opuel s.n. (W)	Para or iso	Gonio	643 543	SO 78	6, 5, 7	24 × 31

from Praglowski (1970, Table 2)). (* Voucher specimens not re-examined).

Colpi (μ)	Pori (μ)	Exine thickness (μ)			Tectal details in LO		Special morphological characteristics
		In polar view		At poles			
		Mesocolpia	Aperture margins		Puncta	Supra-tectal processes	
6 × 2 4 × 0.5		2 - 3	4 - 5	2.5, 1.5	+	—	
6 × 1 5 × 1		2 - 3	3.5 - 6	2, 1	—	—	
4 × 0.5		2.5 - 3	4 - 6	2.5, 1.5	+	—	Ap. distinctly prot., anomotreme grains occur
5 × 1 3 × 1	(2 × 1.5)	2.5 - 3.5	4 - 6	2.5, 2	+	—	Exine comp. thick, ap. prot., anomotreme grains occur, pori rare
8 × 2 6 × 1		2.5 - 3.5	5 - 7	2.5, 2	+	—	Exine comp. thick, ap. prot., anomotreme grains occur, colpi long
5 × 0.5		2 - 2.5	4	2, 1.5	+	+	Anomotreme grains occur
5 × 1.5 4 × 1	(3 × 2)	2	2.5	1.5, 1	+	+	Ap. margins not thickened
5 × 1 4 × 0.5		3	3.5	2, 1	+	—	Ap. not prot.
4 × 1		2	3	2, 1	+	—	Ap. not prot.
(5 × 1.5)	4 × 3	1.5 - 2	3 - 4	1.5, 1.5 1.5, 2	+ +	—	Ap. not prot., 5-3 treme and anomotreme grains occ. occur
5 × 2	(3 × 2)	2 - 2.5	3 - 4	2, 1.5 2, 2	+	—	Ap. not prot., 5-3 treme grains occ. occur
6 × 1 5 × 0.5		2	3	2, 1	—	—	Exine comp. thin
5 × 1		2 - 2.5	3.5 - 4.5	1.5, 1	—	—	
6 × 1 4 × 1		3	4 - 6	1.5, 1	—	—	Ap. prot., tectum und.
6 × 0.5		3	5 - 6	2, 3 2, 2	+	—	Ap. prot., mesocolpia comp. short

	Polarity	Amb	NPC	Shape & P/E index	Type	Size in μ
G. chinensis (Lour.) Orch. subsp. *chinensis*						
China, Hook. 897 (W)	Para or iso	Gonio	643 (543) (743)	SO-O 75	6, 7	27 × 36
Hongkong, K. L. Rechinger s.n. (W)	Para	Gonio	643 543	SO-O 75	6, 5, 7	27 × 37
*Papua, E. G. Crutwell 1036 (K)	Para	Gonio	543 643	SO 76	5, 6, 7	24 × 32
*N. Guinea, Maille s.n. (W)	Para occ. iso	Gonio	543 (443)	SO 80	5	16 × 20
G. philippinensis (Merr.) Orch.						
Sumatra, J. A. Lörzing 9771 (L)	Para occ. iso	Interm	443 (543) (643) (343)	SO 81	4	29 × 36
Sumatra, C. G. G. van Steenis 9083 (L)	Para occ. iso	Peritr-interm	443 (543)	SO 78	4	28 × 36
G. mezianus (Schindl.) Orch.						
Austr. Victoria, Josephine E. Tilden 919 (K)	Para	Interm	543	SO 77	5	22 × 29
S. Austr., J. Jackson 338 (AD)	Para occ. iso	Gonio	543 443	SO 77	5, 4	24 × 31
S. Austr., A. E. Orchard 1810 (AD)	Para occ. iso	Gonio	543 643 (743)	SO 78	5, 6	28 × 36
G. elatus (A. Cunn. ex Fenzl) Orch.						
S. Austr., Kraehenbuehl 1173 (AD)	Para occ. iso	Gonio	443 (543)	O 71	4	15 × 21
S. Austr., D. N. Kraehenbuehl 748 (AD)	Para	Gonio	443 543	SO 84	4, 5	22 × 26
G. leptothecus (F. v. M.) Orch.						
Austr., Northern Terr., R. L. Specht 211 (PERTH)	Para occ. iso	Gonio	543 (643)	SO-O 75	5	24 × 32
G. benthamii Orchard						
*W. Austr., A. Morrison 9557 (K)	Para occ. iso	Gonio	443 444 (343) (344)	SO 78	4	22 × 28
W. Austr., R. D. Royce 100 (PERTH)	Para occ. iso	Gonio	443 444 (343) (344)	SO 78	4	25 × 32
G. intricatus (Benth.) Orch.						
W. Austr., Drummond s.n. (W.)	Para	Gonio	543 443	O 73	5, 4	14 × 19

Colpi (μ)	Pori (μ)	Exine thickness (μ)			Tectal details in LO		Special morphological characteristics
		In polar view		At poles			
		Mesocolpia	Aperture margins		Puncta	Supra-tectal processes	
6 × 1 5 × 0.5		2.5 - 3	5 - 6	2, 1.5	+	—	Ap. prot., colpi occ. arranged in a figure "8" around the equator
6 × 1		2 - 3	4 - 6	2, 1	+	—	Ap. prot., mesocolpia comp. short
4 × 1		2.5	4 - 4.5	2, 1.5	—	—	Tectum und., ap. prot., grains occ. loxocolpate
3 × 0.5		2	2 - 3	2, 1	—	—	Grains comp. small, exine comp. thick
8 × 0.5		2	3 - 4	2, 1.5	+	—	Tectum und., anomotreme grains occ. occur
10 × 1		2 - 2.5	2.5 - 3.5	2, 1.5	+	—	Exine comp. thick, colpi long, ap. margins thickened
4 × 1		2 - 3	3	2.5, 1.5	—	—	Ap. s. ingrooved, not prot.
4.5 × 1		3	4 - 5	2.5, 1.5	—	—	
5 × 1 4 × 0.5		4	5	3, 2	+	—	
4 × 0.5		2	3.5	2, 1.5	—	—	
4 × 1		1.5	3 - 4	1.5, 1	+	—	
4 × 1		2 - 3.5	4 - 5	2, 1.5	+	—	7-8 colpate and anomotreme grains occur, nexine much differentiated
3 × 0.5	4 × 3	2.5	4 - 5	2, 1.5	+	—	Exine comp. thick
4 × 1	4 × 3	3	4 - 6	2.5, 2	+	—	Exine comp. thick
3 × 0.5		2	3	1.5, 1	—	—	

	Polarity	Amb	NPC	Shape & P/E index	Type	Size in μ
G. rudis (Benth.) Orch.						
*W. Austr., Capt. A. D. Smith s.n. (K)	Para occ. iso	Interm	443 (444) (543) (544)	SO 83	4	25 × 30
G. micranthus Thunb. subsp. *micranthus*						
*Japan, Honshu, Hiroe 12635 (W)	Para or iso	Gonio	443 543	SO 79	4, 5	23 × 28
*N. Zealand, Travers s.n. (W)	Para or iso	Gonio	543 643	SO 76	5, 6	26 × 34
G. cordiger (Fenzl) Endl.						
W. Austr., Diels & Pritzel 186 (PERTH)	Para	Gonio	543 (443) (643)	O 63	5	17 × 27
*W. Austr., E. Pritzel s.n. (W)	Para occ. iso	Gonio	443 (543)	SO 78	4	24 × 31
G. pithyoides Nees						
Austr., Preiss 1224 (W)	Iso or para	Interm-peritr	443 (343) (444)	SO 82	4	24 × 29
G. confertifolius (F. v. M.) Orch. var. *helmsii* Orch.						
W. Austr., C. A. Gardner s.n. (PERTH)	Para	Gonio	543 443	SO 78	5, 4, 7	22 × 28
G. nodulosus Nees						
*W. Austr., C. A. Gardner 6481 (PERTH)	Para	Interm	443 (543)	SO 81	4	21 × 26
G. paniculatus (R. Br. ex Benth.) Orch.						
W. Austr., A. Morrison 14118 (K)	Para	Gonio	643 (543) (443)	O 73	6, 7	22 × 30
*W. Austr., Morrison 133 (K)	Para	Gonio	543 643	SO 79	5, 6	30 × 38
G. hexandrus (F. v. M.) Orch. subsp. *serratus* (Schindl.) Orch.						
W. Austr., M. Koch 2259 (K)	Para occ. iso	Interm	443 543	O 72	4, 5	23 × 32

Colpi (μ)	Pori (μ)	Exine thickness (μ) In polar view: Mesocolpia	Exine thickness (μ) In polar view: Aperture margins	Exine thickness (μ) At poles	Tectal details in LO: Puncta	Tectal details in LO: Supra-tectal processes	Special morphological characteristics
4 × 1	(3 × 2)	2 - 2.5	3 - 4	2.5, 1.5	+	+	Ap. not prot., ap. margins comp. thin
5 × 1.5 3 × 0.5		2 - 2.5	4	2, 1.5	+ +	—	Tectum smooth
5 × 1 4 × 0.5		2.5	4 - 5	2, 1.5	+ +	—	6-treme grains rare, tectum smooth
5 × 0.5		2 - 3	4 - 5	2.5, 1.5	—	—	Exine comp. thick, ap. prot.
9 × 0.5 6 × 0.5		2 - 3	4 - 5	2.5, 2	—	—	Tectum occ. s. und., ap. prot., grains distinctly goniotreme
5 × 1 4 × 0.5	3 × 2	2 - 3	4 - 5	2, 1.5	—	—	
4 × 0.5		2.5	3.5 - 4	2.5, 1.5	+	—	Tectum usually undulated
4 × 0.5		2.5	3.5	2, 1.5	—	—	
4 × 1		3 - 4	5	3, 2	+ +	+	Ap. prot., concave mesocolpia, tectum undulated
5 × 0.5 4 × 0.5		2 - 2.5	3.5	2.5, 1.5	+	—	Ap. prot., concave mesocolpia, tectum undulated, grains comp. large
5 × 1 4 × 0.5		2 - 2.5	3 - 4	2, 1.5	+	—	Ap. not prot.

CHROMOSOME NUMBERS

Table 8 summarises chromosome number reports for the genera *Haloragis, Gonocarpus* and *Myriophyllum*. There are apparently no counts for the other genera of the family.

Table 8. Chromosome numbers in Haloragaceae.

Species	n	2n	Reference
Haloragis			
H. erecta		14	Forde, 1964
Gonocarpus (publ. as "Haloragis")			
G. halconensis	56 ("58", p. 143)		Borgmann, 1964
G. micranthus subsp. *micranthus*	6		Chuang et al., 1962
		12	Larsen, 1966
	6		Hsu, 1968
Myriophyllum			
M. alterniflorum var. *alterniflorum*	7		Scheerer, 1939
		14	Joergensen et al., 1958
		14	Larsen, 1965
		14	Gadella & Kliphuis, 1968
M. alterniflorum var. *americanum*		14	Löve & Löve, 1958
M. alternifolium		14	Pogon, 1966
M. indicum	7		Sarkar et al., 1973
M. spicatum var. *spicatum*		28	Löve, 1954
		28	Taylor & Mulligan, 1968
M. spicatum subsp. *exalbescens*		14	Löve, 1954
		42	Packer, 1964
		42	Löve & Ritchie, 1966
M. verticillatum		28	Pogon, 1966

Because of the paucity of chromosome counts for *Gonocarpus* and *Haloragis* and the apparent lack of any information for *Laurembergia, Glischrocaryon, Haloragodendron, Meziella* and *Proserpinaca,* it is difficult to draw meaningful conclusions about relationships.

The *Myriophyllum* species show a polyploid series up to the hexaploid state, with a base number of x = 7, which agrees with the one count for *Haloragis. Gonocarpus halconensis* could be fitted into this series, with its sporophyte number of 56 representing the octoploid state, but *G. micranthus* (n = 6, 2n = 12) seems to have a base number of x = 6.

All of the New Zealand species of *Gunnera* have a somatic complement of 34 chromosomes (Beuzenberg & Hair, 1963) and in this agree with *G. insignis* (n = 17, 2n = 34; Virkki, 1962). *G. chilensis* (n = ca 12; Winge, 1917) and *G. macrophylla* (n = 12; Samuels, 1912 and 2n = 24; Borgmann, 1964) have much lower counts. With the exception of the latter two species, the basic chromosome number of x = 17 lends weight to the separation of *Gunnera* from Haloragaceae. Similarly, the affiliation of *Trapa* (2n = 40, 48, x = 4?; Trela-Sawicka, 1965) and *Hippuris* (n = 14, 16 and 2n = (30) 32 (48); Winge, 1917, Harada, 1952, Joergensen et al., 1958, Sokolovskaja, 1960, Gadella & Kliphuis, 1963, 1966, Zhukova, 1966, and Löve & Ritchie, 1966) with Haloragaceae is not supported by the chromosomal evidence. *Callitriche* shows a well defined polyploid series up to the octoploid state, based on x = 5 (Savidge, 1956; Shimoyama, 1958; D. M. Moore, 1960; Sokolovskaja, 1960; Beuzenberg & Hair, 1963).

Griselinia and *Corokia*, two basically New Zealand genera of uncertain affinity (often placed in Cornaceae) have a basic number of x = 9 (Hair & Beuzenberg, 1959), with *Corokia* attaining the diploid state and *Griselinia* the tetraploid.

Very little lead as to affinity can be expected from a comparison of the counts listed above with those of putatively related families for two main reasons. Firstly, only comparisons between closely related

families could reasonably be expected to yield agreement in a character as variable as the chromosome number. As so many of the genera above are usually considered "of doubtful affinity" it is unlikely that they have any extant close relatives. Secondly, the variability of base numbers even between the genera *Gonocarpus* and *Myriophyllum* (x = (6-) 7), which are probably fairly closely related, makes wider comparison seem of doubtful validity.

PHYTOCHEMISTRY

Comparative information in this field is very fragmentary as far as Haloragaceae are concerned. The available facts are best summarised under the headings polyphenols, saponins, cyanogenic compounds and alkaloids. Species names have been changed where necessary to agree with those used in the Taxonomy section (Section IV).

POLYPHENOLS: Cambie et al. (1961) found leucoanthocyanins in *Haloragis erecta* ssp. *erecta* and ssp. *cartilaginea, Gonocarpus aggregatus, G. montanus, Myriophyllum votschii* and *M. pedunculatum.* These compounds were absent in *Gonocarpus incanus, My iophyllum robustum, M. propinquum, M. elatinoides* and six species of *Gunnera.* These results were confirmed in part by Bate-Smith (1962) who found no leucoanthocyanins in *Gunnera manicata* or *Myriophyllum proserpinacoides* but found leucocyanidin in *Haloragis erecta.* In the same paper, the presence of the flavonol quercetin in all three species, and kaemferol in *Haloragis* and perhaps *Gunnera,* bu not *Myriophyllum,* was also reported. Of other identifiable phenolic compounds, *Gunnera* contained ellagic acid, caffeic acid, p-coumaric acid and perhaps a trace of ferulic acid, *Haloragis* contained ellagic acid, caffeic acid and perhaps p-coumaric acid, while *Myriophyllum* only contained ellagic acid.

SAPONINS: Cambie et al. (1961) reported a positive saponin test for *Gonocarpus montanus* and doubtfully positive tests for *Haloragis erecta* subsp. *erecta, Gunnera strigosa* and *Gunnera arenaria.* However, *H. erecta* subsp. *cartilaginea,* two species of *Gonocarpus,* four species of *Gunnera* and five species of *Myriophyllum* returned a negative test. Saponins were also absent in four species of *Gunnera* and three species of *Myriophyllum* in Chile, tested by Ricardi et al. (1958).

CYANOGENIC COMPOUNDS: The Poison Plants Committee (1929) reported that six specimens of an unidentified species of *Haloragis* had been found to be cyanogenic. Mirande (1913) found *Haloragis erecta* to be cyanogenic and Hegnauer (1958) found 1.8 mg HCN/kg freshweight of *Myriophyllum brasiliense.* However, Webb (1949) found no trace of HCN in *Gonocarpus tetragynus* and *Myriophyllum propinquum.* Aplin (1968) reported that *Glischrocaryon aureum* and *G. roei* gave positive reactions for HCN.

ALKALOIDS: Webb (1949) found traces of alkaloid in the roots of *Gonocarpus tetragynus,* but none in the leaves, and none in *Myriophyllum propinquum.* Webb (1952) detected no alkaloids in *Haloragis heterophylla,* and Cambie et al. (1961) reported alkaloids absent from their species of *Haloragis, Gonocarpus, Gunnera* and *Myriophyllum.*

The data outlined above are too sparse to make a detailed comparison with other families worthwhile. Hegnauer (1966) considered that on the chemical evidence, *Hippuris* was not closely related to Haloragaceae, but could well fit into the Tubiflorae. The position for the Haloragaceae was considered to be in the Myrtales. Callitrichaceae are so imperfectly known that Hegnauer refrained from assigning them to any position on the chemical evidence.

Bate-Smith (1962) divided the families from which polyphenolic content data were available into four groups, ab, a_0b, ab_0 and a_0b_0 depending on whether leucoanthocyanins were present or absent (a or a_0) and whether trihydroxy constituents were present or absent (b or b_0). Because the conversions $a \rightarrow a_0$ and $b \rightarrow b_0$ were considered virtually irreversible, the group ab would be the most primitive and the group a_0b_0 the most derived in this respect. Of the families listed earlier as putative relatives of the Haloragaceae, the group ab contains Celastraceae, Rhizophoraceae and Haloragaceae, the group a_0b contains Lythraceae, Combretaceae, Onagraceae and Cornaceae, the group ab_0 none, and the group a_0b_0 contains Callitrichaceae, Aquifoliaceae, Datiscaceae, Hippuridaceae, Araliaceae and Apiaceae. Thus on the evidence from polyphenolic constituents, this last group of families (a_0b_0) is least likely to be closely related to Haloragaceae (ab). *Gunnera* considered separately from Haloragaceae, falls into the group a_0b, while the rest of the family (so far as known) falls fairly consistently into ab.

REVIEW OF FOSSIL RECORDS

This aspect of Haloragaceae has been ably summarised by Praglowski (1970), and will not be reiterated in detail here. Most of the fossil records are of pollen, and thus, because of the similarity in pollen morphology of most genera of Haloragaceae, cannot be accurately referred to individual species or (sometimes) even to genera.

Fossil pollen assigned to *Myriophyllum* spp. is known from Oligocene and Miocene deposits in New Zealand, from the Miocene of Madras and from the Middle Eocene of Colorado and Utah. Numerous records of fossil *Myriophyllum* pollen, seeds and fruits are known from the inter- and post-glacial deposits of Britain and Europe.

Pollen similar to that of *Haloragis* has been found in the Oligocene of New Zealand, and the Pliocene of Western Australia, Victoria and Queensland whereas pollen similar to that of *Gonocarpus* has been found in the Eocene of Burma.

Fossil fruits of *Proserpinaca* and *Myriophyllum* are known from Pliocene and Miocene deposits of Europe and Siberia. *Proserpinaca* is now confined to the Americas, from Nova Scotia to Brazil (Raven, 1962). With this exception, the fossil evidence shows a distribution pattern for the genera of Haloragaceae which is more or less unchanged from the late Tertiary to the present

Praglowski (1970) suggested that some members of the widespread Tertiary and late Cretaceous sporomorph Stemma Normapolles have similarities with the pollen of Haloragaceae, particularly *Haloragis*. On this basis he proposed that during the Tertiary Haloragaceae (or their immediate progenitors) were much more widespread than at present, and occurred "throughout Euro-Asia and the palaeo-subantarctic areas".

In view of the close similarity that Praglowsk himself found between the pollen of *Haloragis, Gonocarpus, Proserpinaca, Laurembergia* and *Myriophyllum,* and the similarity between the pollen of Haloragaceae and such typically European families as Ulmaceae and Betulaceae (Praglowski, 1970; Erdtman, 1966), it seems premature to suggest that the Normapolles fossils of Eurasia are more likely to be proto-*Haloragis* than they are likely to be proto-*Myriophyllum* or even proto-*Ulmus*. Until a more complete series of fossils between Normapolles and *Haloragis* can be demonstrated, it seems better to postulate a basically Southern Hemisphere origin for Haloragaceae, at least as far back as the Oligocene. The presence of the aquatic genera *Myriophyllum* and *Proserpinaca* in the Northern Hemisphere in the Tertiary can probably be explained by either long-distance dispersal, or movement through the tropics via their aquatic (and therefore relatively uniform) environment.

IV. TAXONOMY

Family HALORAGACEAE

HALORAGACEAE R. Brown in Flinders, Voy. Terra Aust. 2 App. 3 (1814) 549 ['Halorageae'] [Type genus: *Haloragis* Forst. & Forst. f.] Gray, British Pl. 2 (1821) 555; Reichenbach, Consp. Reg. Veg. (1828) 169; DC., Prod. 3 (1828) 65-72; Dumort., Anal. fam. (1829) 39 ['Haloragideae']; Lindley, Nat. Syst. (1830) 57; Bartling, Ord. Nat. Pl. (1830) 314; Don, Gen. Hist. Dichlam. Pl. 2 (1832) 701; Reichenbach, Fl. Germ. (1832) 632; Wight & Arn., Prod. (1834) 337; Spach, Veg. Phan. 4 (1835) 442; Meisner, Pl. Vasc. Gen. (1838) 122 [subord. Onagracearum]; Endl., Gen. Pl. (1840) 1195; Endl., Enchir. (1841) 639; Walp., Rep. 2 (1843) 98 ('89')-100; Nees in Lehm. Pl. Preiss. 1 (1844) 158-159; Raoul, Choix Pl. N.Z. (1846) 48; Walp., Rep. 5 (1846) 671-672; Lindley, Veg. Kingd. (1846) 722 ['Haloragaceae']; Nees in Lehm., Pl. Preiss. 2 (1848) 224-226; A. Gray, Bot. U.S. Expl. Exped. 1 (1854) 624-634 [subord. Onagracearum]; Hook. f., Fl. Tas. 1 (1856) 119-124; Sonder, Linnaea 28 (1856) 229-234; Benth., Fl. Aust. 2 (1864) 470; Benth. & Hook., Gen. Pl. (1865) 673-677; Le Maout & Decaisne, Gen. syst. (1873) 414-416; Clarke in Hook. f., Fl. Brit. Ind. 2 (1878) 430-434; F.v.M., Census 1 (1882) 49-50; Bailey, Syn. Qld. Pl. (1883) 156-158; F.v.M., Key Syst. Vict. Pl. 2 (1885) 22, 1 (1887-8) 259; F.v.M., Sec. Census 1 (1889) 85-86; Featon, Art. Alb. N.Z. Fl. 1 (1889) 147-153; Tate, Fl. S. Aust. (1890) 100-102, 233-234; Moore, Hdbk. Fl. N.S. Wales (1893) 184-187; Kirk, Stud. Fl. N.Z. (1899) 147-156; Petersen, Pflfam. III 7 (1893) 226-237 ['Halorrhagidaceae']; Bailey, Qld. Fl. 2 (1900) 552-558; Rodway, Tasm. Fl. (1903) 48-50; Diels & Pritzel, Bot. Jb. 35 (1904) 444-449; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 1-77; Schindler, Pflrch 23 (1905) 1-133 ['Halorrhagaceae']; Cheeseman, Man. N.Z. Fl. (1906) 147-159; Dixon, Pl. N.S. Wales (1906) 129-131; Merrill, Philipp. J. Sci. 1, Suppl. (1906) 216; Britten, J. Bot. 45 (1907) 135-137; Cheeseman, Trans. N.Z. Inst. 42 (1909) 201-203; Bailey, Cat. Qld. Pl. (1913) 174-175; Guillaumin, Bull. Soc. Bot. France 61 (1914) 8-12; Maiden & Betche, Census N.S. Wales Pl. (1916) 158-159; Ewart & Davies, Fl. N. Terr. (1917) 214-215; Guillaumin, Fl. Gen. I.-C. (1920) 714-718; Cheeseman, Man. N.Z. Fl. 2 ed. (1925) 619-630 ['Haloragidaceae']; Black, Fl. S. Aust. (1926) 428-432; Mansfeld, Bot. Jb. 61 (1927) 26-27; Domin, Bibl. Bot. 89 (1929) 1034-1036; Ewart, Fl. Vict. (1931) 878-887; Gardner, Enum. (1931) 99-100; van Steenis, Bull. Jard. Bot. Buitenz. III. 13 (1934) 217-218; Merrill & Perry, J. Arn. Arb. 23 (1942) 407; Black, Fl. S. Aust. 2 ed. (1952) 640-647; Curtis, Stud. Fl. Tasm. 1 (1956) 186-191; Hutchinson, Fam. Fl. Pl. 2 ed. 1 (1959) 448-449; Gardner, Wildfls. W. Aust. (1959) 119-120; Bullock, Taxon 8 (1959) 175; Moore in Allan, Fl. N.Z. 1 (1961) 241-253; Evans in Beadle, Evans & Carolin, Vasc. Pl. Syd. Distr. (1963) 174-176 ['Haloragiaceae']; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 463-474; Ohwi, Fl. Jap. (1965) 659-661; Tardieu-Blot, Fl. Camb. Laos Viet. 4 (1965) 117-123; Raynal, Adansonia ser. 2, 6 (1967) 537-543; Burbidge & Gray, Fl. A.C.T. (1970) 279-280; Praglowski, Grana 10 (1970) 159-239; v.d. Meijden & Caspers, Fl. Males. 7 (1971) 239-263; Willis, Hdbk. Pl. Vict. 2 (1972) 467-472; Beadle et al., Fl. Syd. Reg. (1972) 206-8; Aston, Aq. Pl. Aust. (1973) 76-98.

HYGROBIAE L. C. M. Richard, Dem. Bot. (1808) 34; Cambess. in St. Hil., Fl. Bras. 2 (1830) 250-252 ['Hygrobieae']; Spach, Veg. Phan. 4 (1835) 442-443 [trib. Haloragarum].

CERCODIANAE Jussieu, Dict. Sci. Nat. 5 (1817) 441-442.

Annual or perennial aquatic or terrestrial herbs or small shrubs, glabrous or scabrous with simple uniseriate hairs. Stems creeping, procumbent, ascending or erect, often rooting at the lower nodes. Leaves decussate, spiral or whorled, exstipulate, sessile or petiolate, simple, blades entire, toothed or deeply dissected, midrib usually ± channelled above, prominent below.

Inflorescence an indeterminate or determinate spike of dichasia (or monochasia, or single flowers) borne in the axils of leaf-like primary bracts. Lateral inflorescences similar to, but usually simpler than the main one, are borne in the axils of the upper leaves. Where the inflorescence consists of many-flowered dichasia, the flowers are subtended by membranous, persistent or deciduous, secondary, tertiary and higher order bracts.

Flowers actinomorphic, choripetalous, epigynous, protandrous, anemophilous or entomophilous, cream, green or reddish, bisexual or unisexual-monoecious. Sepals (2-3-) 4 (absent in female flowers of *Myriophyllum*), linear, deltoid, ovate or cordate, lacking ribs, or with a prominent midrib, ± median basal callus. Petals same in number as sepals (absent in *Proserpinaca* and female flowers of *Myriophyllum* and *Laurembergia*), imbricate, hooded or navicular, ± unguiculate, ± keeled, deciduous with stamens. Stamens equal to or twice the number of sepals, filaments short, slender; anthers 4-locular, dehiscing by slits, (linear-) oblong (reniform in *Proserpinaca*), the connective sometimes produced to form an apiculum, the antisepalous anthers sometimes ± longer than antipetalous ones. Pollen grains paraisopolar to isopolar, radially symmetrical, pertectate, 4-5 (-6)-colpate or 4-5-porate, crassimarginate or tenuimarginate, frequently aspidote, polar axis 16-35 μ, equatorial diameter 20-40 μ, suboblate, oblate-spheroidal or rarely spheroidal or oblate, peritreme to goniotrene. Microspore cytokinesis is simultaneous and the grains are shed at the 3-celled stage.

Styles same in number as sepals (rarely, half as many), clavate, ± bulbous based, convergent at tips until anthers shed, stigmas ± capitate, fimbriate. Ovary syncarpous, smooth or longitudinally ribbed opposite sepals and petals, ± (2-3-) 4-celled, septa solid, of up to 7 cells in thickness, or insubstantial or practically absent (present only at base and apex of ovary). Ovules 1-2 per locule (if 2, then 1 aborts

at an early stage), pendulous, anatropous, bitegmic, and crassinucellar, with porogamous fertilisation. Embryo sac development of Polygonum type; endosperm *ab initio* Cellular or Nuclear; embryogeny conforms to the Myriophyllum-variation of the Caryophyllad type.

Fruit an indehiscent 1-4-seeded nut (splitting into four 1-seeded nutlets in *Myriophyllum*), usually ± ovoid, but variously ornamented with wings, ribs and tubercles. Pericarp ± membranous or endocarp (and septa, if present) woody, exocarp membranous or swollen and spongy. Sepals persistent, erect or reflexed, enclosing styles or styles reflexed between them.

A family of eight genera and about 100 species, distributed mainly in the Southern Hemisphere, particularly in Australia; *Myriophyllum* is cosmopolitan and *Proserpinaca* is confined to the Northern Hemisphere. The species are found in most types of habitat, although rare in tropical rain forest, and absent in marine environments.

Numerous different spellings of the name for this family have been proposed since Brown's recognition of the family in 1814. The spelling Haloragaceae is conserved under the International Code of Botanical Nomenclature (see Bullock, 1959).

In his paper of 1904 Schindler used many of the new names and new combinations later published in his monograph (1905). As he cited many of these names as "ined." in the earlier paper it is considered that he did not accept them as being validly published in this paper, and they therefore date from 1905.

Key to the genera of Haloragaceae

1. All flowers with petals.
 2. Leaves entire or toothed, rarely deeply dissected (if dissected, then lacking tooth in the sinus between the segments).
  3. Petals hooded; anthers non-apiculate; inflorescence indeterminate.
   4. Fruits (2-3-) 4-locular, pericarp ± woody, septa solid; flowers in (1-) 3-7-flowered dichasia in the axils of alternate primary bracts. — *Haloragis*
   4. Fruits 1-locular, pericarp membranous, septa absent; flowers solitary (rarely 1-3) in axils of alternate or opposite primary bracts. — *Gonocarpus*
  3. Petals navicular; anthers usually apiculate; inflorescence determinate.
   5. Leaves serrate; inflorescence narrow, spike-like. — *Haloragodendron*
   5. Leaves entire; inflorescence broad, pseudo-umbelliform. — *Glischrocaryon*
 2. Leaves trifid, with small tooth in the sinus between the lobes. — *Meziella*
1. At least female flowers lacking petals (petals rudimentary in *Proserpinaca*).
 6. Fruit indehiscent.
  7. Fruit 1-locular; flowers predominantly unisexual; anthers linear-oblong. — *Laurembergia*
  7. Fruit 3-locular; flowers bisexual; anthers ellipsoid. — *Proserpinaca*
 6. Fruit splitting at maturity into 2-4 nutlets. — *Myriophyllum*

Genus **HALORAGIS**

Haloragis Forst. et Forst. f., Char. Gen. (1775) 61, t. 31 [Type species: *Haloragis prostrata* Forst. et Forst. f.]; L'Herit., Stirp. Nov. (1788) 82; Dryand. in Aiton, Hort. Kew 2 (1789) 37; Drake (?), in Rees, Cyclop. 16 (1811); Brown, App. Flinders Voy. 2 (1814) 550 p.p.; DC., Prod. 3 (1828) 66; Wight & Arn., Prod. (1834) 338 p.p.; Lindl., Nat. Syst. 2 ed. (1836) 37 p.p.; Walp., Rep. 2 (1843) 99 p.p.; Walp., Rep. 5 (1846) 672; Hook. f., Fl. N.Z. 1 (1852) 62 p.p.; Gray, Bot. U.S. Expl. Exped. 1 (1854) 624 p.p.; Hook. f., Fl. Tas. 1 (1856) 119 p.p.; 2 (1859) 162 p.p.; Benth., Fl. Aust. 2 (1864) 473 p.p.; Benth. & Hook. Gen. Pl. 1 (1865) 674, 675 p.p.; LeMaout & DeCaisne, Gen. Syst. Bot. (1873) 414 p.p.; Eichler, Bluethendiag. (1875) 463-464 p.p.; Hook. f., Fl. Brit. India 2 (1878) 430 p.p.; Baill., Nat. Hist. Pl. 6 (1880) 500 p.p.; F.v.M., Census 1 (1882) 49 p.p.; Bailey, Syn. Qld. Fl. (1883) 156 p.p.; F.v.M., Key Syst. Vict. Pl. 2 (1885) 22, 1 (1887-8) 261, p.p.; F.v.M., Sec. Census 1 (1889) 85 p.p.; Featon, Art Alb. N.Z. Fl. (1889) 147 p.p.; Tate, Fl. S. Aust. (1890) 101 p.p.; Petersen, Pflfam. 3 (1893) 227-233 p.p. ['Halorrhagis']; Moore, Fl. N.S. Wales (1893) 185; Bailey, Qld. Fl. 2 (1900) 552 p.p.; Rodway, Tas. Fl. (1903) 48 p.p.; Diels & Pritzel, Bot. Jb. 35 (1904) 445, 446 p.p.; Schindler, Pflrch 23 (1905) 19 p.p.; Dixon, Pl. N.S. Wales (1906) 129, 130 p.p.; Merrill, Philip. J. Sci. 1 Suppl. (1906) 216 p.p.; Britten, J. Bot. 45 (1907) 135-137 p.p.; Cheeseman, Trans. N.Z. Inst. 42 (1909) 201-203 p.p.; Bailey, Cat. Qld. Pl. (1913) 174 p.p.; Maid. & Betche, Cens. N.S. Wales Pl. (1916) 158 p.p.; Ewart & Davies, Fl. N. Terr. (1917) 214 p.p.; Went, Nova Guinea 14 (1924) 105-106 p.p.; Cheeseman, Fl. N.Z. 2 ed. (1925) 620 p.p.; Black, Fl. S. Aust. (1926) 429 p.p.; Mansfeld, Bot. Jb. 61 (1927) 26 p.p.; Domin, Bibl. Bot. 89 (1929) 1034 p.p.; Ewart, Fl. Vict. (1931) 879 p.p.; Gardner, Enum. (1931) 99 p.p.; van Steenis, Bull. Jard. Bot. Buitenz. III, 13 (1934) 217-218 p.p.; Black, Fl. S. Aust. 2 ed. (1952) 641 p.p.; Curtis, Stud. Fl. Tasm. 1 (1956) 187 p.p.; Gardner, Wildfl. W. Aust. (1959) 120 p.p.; Evans in Beadle, Evans & Carolin, Hdbk. Pl. Syd. Dist. (1963) 174 p.p.; Ohwi, Fl. Japan (1965) 660 p.p.; Blackall & Grieve, W. Aust. Wildfl. 3 (1965) 463, 464 p.p.; Praglowski, Grana 10 (1970) 159-239 p.p.; Burbidge & Gray, Fl. A.C.T. (1970) 279 p.p.; Willis, Hdbk. Pl. Vict. 2 (1972) 467 p.p.; Beadle et al., Fl. Syd. Reg. (1972) 206.

Cercodia Banks ex Murray, Comm. Goett. (1780) 3-8 [Type species: *C. erecta* Banks ex Murray]; Lam., Encycl. Meth. 1 (1785) 682 et Tabl. Enc. 1 (1797) t. 319 ['*Cercodea*']; DC., Prod. 3 (1828) 67; Lindl., Nat. Syst. 2 ed. (1836) 37; Cunningham, Ann. Nat. Hist. 3 (1839) 29.

Meionectes R. Br., App. Flinders Voy. 2 (1814) 550 [Type species: *M. brownii* Hook. f.]; Hook. f. in Hook., Icones Pl. 4 (1841) t. 306; Lindl., Nat. Syst. 2 ed. (1836) 37 ['*Mejonectes*']; Endl., Gen. Pl. Suppl. 2 (1842) 93; Walp., Rep. 2 (1843) 98, 5 (1846) 671 ['*Meionectis*']; Nees in Lehm., Pl. Preiss. 2 (1848) 224 [on p. 225, '*Mejonectes*']; Hook., f., Fl. Tasm. 1 (1856) 123; Benth., Fl. Aust. 2 (1864) 486; Benth. & Hook., Gen. Pl. 1 (1865) 675; LeMaout & DeCaisne, Gen. Syst. (1873) 414; Eichler, Bluethendiag. (1875) 463, 464; F. v. M., Census 1 (1882) 50; F. v. M., Trans. R. Soc. Vict. 24 (1888) 137 pro syn. *Haloragis*, ['*Meinoctes*' sphalm]; Petersen, Pflfam. 3 (1893) 233; Dixon, Pl. N.S. Wales (1906) 130.

Annual or perennial herbs or subshrubs 10-80 (-150) cm tall, rootstock a simple taproot or a deep horizontal stolon, stems prostrate, ascending or erect, smooth or 4-5-ribbed, herbaceous or woody towards base, sometimes rooting in lower part, glabrous, scabrous or pilose with various types of simple hairs.

Leaves alternate or opposite, terete, linear, lanceolate or ovate, simple to pinnatifid, margin entire or (usually) serrate, midrib sunken above, prominent (rarely obscure) below, petiolate or sessile, exstipulate, glabrous, scabrous or pilose with hairs as for stems.

Inflorescence an indeterminate spike of (1-) 3-7-flowered dichasia in the axils of alternate primary bracts. Lateral inflorescences usually borne in the axils of the upper leaves. Primary bracts leaflike, grading into upper leaves at base of inflorescence, becoming ± rapidly reduced in size and serrations towards apex. Secondary, tertiary etc. bracts brown, linear, membranous, much smaller than primary bracts.

Flowers 2-3- or 4-merous on short pedicels. Sepals 2, 3 or 4, usually smooth, deltoid, glabrous, scabrous or pilose. Petals same in number as sepals, hooded, ± unguiculate, keeled glabrous or pilose or scabrous on keel. Stamens twice the number of sepals (equal in *H. stokesii*), filaments short; anthers 4-locular, non-apiculate, oblong, antisepalous anthers slightly longer than antipetalous ones. Styles same in number as sepals, clavate, stigmas capitate. Ovary ovoid to hemispherical, smooth, or ribbed opposite petals and/or sepals, glabrous, scabrous or pilose, with 2, 3 or 4 locules, each with 1 (-2) pendulous ovules (if 2, then 1 aborts at an early stage).

Fruits extremely variable in shape, smooth or ribbed opposite sepals and/or alternating with them, or winged between sepals, and/or with massive protuberant processes opposite sepals, or covering entire fruit, smooth or tuberculate between ribs or wings; sepals persistent, usually deltoid, erect or reflexed, ± smooth; 2, 3 or 4 locules, septa and endocarp solid, ± woody, exocarp membranous or spongy; 1-4 seeds (potentially 1 per locule, but fruit forms normally whether all seeds develop or not).

Haloragis, a genus of 26 species, is confined almost entirely to Australia, where it grows in all but the tropical and subtropical areas in the extreme north. The only extra-Australian species are the type, *H. prostrata*, which is endemic to New Caledonia and nearby islands, *H. erecta* in New Zealand, Chatham and the Kermadec Islands, *H. stokesii*, endemic to Rapa Island, and *H. masatierrana* and *H. masafuerana* which are found in the Juan Fernandez islands.

The species of the genus occupy a wide variety of habitats, ranging from obligate aquatics (*H. brownii*) to desert ephemerals (*H. gossei*). They are found on deep sand (*H. acutangula*) or heavy clays (*H. heterophylla*), on shallow soils over limestone (*H. acutangula*), on the sea shore (*H. prostrata*) or only inland (*H. uncatipila*), in tussocks within swamps (*H. myriocarpa*), confined to river banks (*H. exalata*) or semi-arid savannah woodland (*H. odontocarpa*). Many species favour disturbed habitats, spreading by means of a deep stoloniferous rootstock, and have become serious weeds in pastures in some areas (*H. heterophylla, H. glauca*). The only major habitat types which *Haloragis* avoids within its range are salty areas (although one collection of *H. erecta* is claimed to have come from "salt marshes" (Scott CHR87914), and several species are coastal), rain forest and subtropical areas, and alpine localities where snow habitually persists on the ground during winter. Flowering and fruiting times may be irregular (in ephemeral species e.g. *H. gossei*) but are usually during the drier summer period of about October to March. Pollination is probably mainly anemophilous, but in at least one species (*H. acutangula*), can be entomophilous. Most species are potentially perennial, dying back to the rootstock and lower branches after fruiting, and shooting again during the following winter/spring.

The Forsters (1775) spelt the name of this genus "*Haloragis*" and this original spelling was observed until 1893 when Petersen changed the spelling of the genus and family to "*Halorrhagis*" and "Halorrhagidaceae" respectively, presumably to bring them into line with classical usage. Petersen was followed by Schindler in the spelling of the genus, but Schindler called the family "Halorrhagaceae", and coined the names for the subfamily "Halorrhagoideae", tribe "Halorrhageae", and subgenera "Euhalorrhagis" and "Pseudohalorrhagis". Schindler's spellings have been followed since 1905 by most authors. However, under

the International Code of Botanical Nomenclature a name may not be changed because it fails to comply with classical usage. The original spelling must be followed therefore, and Petersen's and Schindler's names are to be considered as orthographic variants. [The name Haloragaceae for the family is conserved. International Code of Botanical Nomenclature ed. 1972, p. 229.]

Cercodia was first reduced to synonymy with *Haloragis* by L'Heritier (1788) and he was followed by most subsequent authors, although A. P. de Candolle (1828), Lindley (1836) and A. Cunningham (1839) maintained *Cercodia* as a distinct genus.

Meionectes was described by Robert Brown (1814) to include species differing from *Haloragis* in their number of floral parts (bimerous flowers instead of tetramerous). The genus was subsequently typified by J. D. Hooker's *M. brownii*. Baillon (1877) was the first author to reduce *Meionectes* to synonymy under *Haloragis,* pointing out the existence of intermediate (trimerous) species. Although this reduction in status was not immediately accepted by all authors, it was adopted by Schindler (1904, 1905) and is now generally agreed to be correct.

Gonocarpus was considered synonymous with *Haloragis* by R. Brown (1814), and he was followed by most authors (with the notable exception of de Candolle). In the present study *Gonocarpus* is reinstated as a distinct genus on the basis of differences in the inflorescence and in fruit and seed morphology and development.

Key to the species of *Haloragis*

1. Vegetative leaves opposite, at least in the lower parts, (linear-) lanceolate to ovate, never pinnatifid or terete.
    2. Ovary 4-locular, styles 4.
        3. Fruit becoming 3-locular by abortion, leaves coriaceous. — 9. *H. eichleri*
        3. Fruit 4-locular, leaves thin.
            4. Leaves sessile.
                5. Leaves lanceolate to oblong, (4.0-) 6.0-10.0 cm long, 1.3-2.5 cm wide. — 1. *H. exalata* subsp. *exalata*
                5. Leaves not as above.
                    6. Leaves spathulate, ± entire, 1.5-3.0 cm long, 0.5-0.8 cm wide; plant prostrate, glabrous, [New Caledonia]. — 7. *H. prostrata*
                    6. Leaves linear-lanceolate, entire or finely serrate, 2.5-4.0 cm long, 0.2-0.5 cm wide, plant erect, scabrous. [Australia] — 2. *H. stricta*
            4. Leaves petiolate; petioles at least 0.2 cm long.
                7. Lamina ovate to orbicular.
                    8. Fruits ovoid, with 4 deltoid wings or ribbed between sepals, glabrous or scabrous.
                        9. Sepals 0.8-1.2 mm long, petals (1.6-) 2.0-2.2 mm long, 0.6-0.7 mm wide (keel to margin). [New Zealand, Chatham and Kermadec Is.] — 3. *H. erecta*
                        9. Sepals 0.6-0.8 mm long, petals (1.8-) 2.2-2.3 mm long, 0.5-0.6 mm wide (keel to margin). [Juan Fernandez Is.] — 4. *H. masafuerana*
                    8. Fruits ovoid, without wings or ribs between sepals, glabrous. [Juan Fernandez Is.] — 5. *H. masatierrana*
                7. Lamina spathulate or narrow-lanceolate.
                    10. Lamina narrow-lanceolate, finely serrate with 30-40 teeth, 5.5-6.0 cm long, 0.6-0.8 cm wide, densely velvety tomentose. — 1. *H. exalata* subsp. *velutina*
                    10. Lamina spathulate, entire, 1.5-3.0 cm long, 0.5-0.8 cm wide, glabrous. — 6. *H. prostrata*
    2. Ovary 2-locular, styles 2.
        11. Stamens 8; sparsely scabrid plant; flowers and fruits ± sessile. — 8. *H. serra*
        11. Stamens 4; densely velutinous plant; flowers and fruits on long peduncles and pedicels. — 6. *H. stokesii*
1. Vegetative leaves all alternate, rarely opposite in lower parts and then leaves pinnatifid, trifid, multifid or terete.
    12. Leaves distinctly petiolate (petiole at least 0.5 cm long).
        13. Flowers tetramerous, fruits ± 4-winged or wingless. — 10. *H. odontocarpa*
        13. Flowers trimerous, fruits 3-winged.
            14. Fruiting sepals lacking lateral veins, wings membranous without semi-transparent "windows". — 11. *H. gossei*
            14. Fruiting sepals with midrib and 2 lateral veins, wings woody with 2-4 semi-transparent "windows". — 12. *H. trigonocarpa*
    12. Leaves sessile or very shortly petiolate (petiole less than 0.5 cm long).
        15. Ovary and fruit 4-locular.

16. Leaves narrow-lanceolate to narrow-ovate (never terete, multifid or pinnatifid), serrate at least in upper part.
    17. Plants scabrous.
        18. Hairs curved, 1-2-celled, 0.1-0.3 (-0.4) mm long.
            19. Plants lacking stoloniferous rootstock.
                20. Flowering sepals deltoid, fruiting sepals deltoid, about as broad as long, (1.0-1.2 x 0.8-1.0 mm). 13. *H. acutangula*
                20. Flowering sepals cordate, fruiting sepals unknown. 17. *H. foliosa*
            19. Plants with stoloniferous rootstock.
                21. Flowering sepals cordate, fruiting sepals unknown. 17. *H. foliosa*
                21. Flowering sepals linear-lanceolate, fruiting sepals linear, 1½-2 times as long as broad, (1.0-1.5 x 0.4-0.5 (-1.0) mm). 16. *H. glauca*
        18. Hairs hooked at tip, 2-4-celled, 0.1-0.5 mm long.
            22. Fruit ovoid, pyriform or globular, exocarp not swollen or spongy, sepals erect in fruit. 14. *H. aspera*
            22. Fruit globular, exocarp swollen, spongy, sepals erect or reflexed in fruit. 15. *H. uncatipila*
    17. Plants glabrous or with papillose hairs.
        23. Plants glabrous; fruits of various shapes.
            24. Fruiting sepals deltoid, about as long as broad (1.0-1.2 x 0.8-1.0 mm); leaves green. 13. *H. acutangula*
            24. Fruiting sepals linear, longer than broad (1.0-1.5 x 0.4-0.5 mm); leaves glaucous. 16. *H. glauca*
        23. Plants with unicellular, transparent papillose hairs 0.1-0.2 mm long; fruit depressed globular; exocarp swollen, spongy. 18. *H. platycarpa*
16. Leaves terete, multifid or pinnatifid, margins not serrate.
    25. Leaves multifid or trifid, scabrous with hairs hooked at the tip, or rarely glabrous. 22. *H. heterophylla*
    25. Leaves terete, glabrous or very sparsely scabrous with short, thick, curved 1-2 celled hairs, margins sometimes very weakly tubercularly toothed. 23. *H. myriocarpa*

15. Ovary and fruit (1-) 2-3 celled.
    26. Leaves linear to narrow-lanceolate.
        27. Plants scabrous.
            28. Fruit scabrous; leaves (1.0-) 1.5-2.0 (-3.0) cm long, weakly toothed or entire.
                29. Fruit with swollen pericarp, 1.8-3.0 mm diam.; hairs hooked at tip; shrub. 20. *H. hamata*
                29. Fruit (usually) with membranous pericarp, 0.9-1.0 (-1.4) mm diam.; hairs straight; herb. 24. *H. digyna*
            28. Fruit glabrous; leaves 2.0-2.5 (-4.5) cm long, coarsely toothed. 19. *H. aculeolata*
        27. Plants glabrous.
            30. Leaves 4.0-6.0 (-7.5) cm long, 0.2-0.4 (-0.7) cm wide, strongly serrate with 2-4 (-8) teeth in upper part; fruit 2-locular. 21. *H. scoparia*
            30. Leaves (1.0-) 1.5-2.0 (-2.3) cm long, (1.0-) 1.5-2.0 mm wide, entire or weakly serrate with 1-4 teeth; fruit 1-3-locular. 24. *H. digyna*
    26. Leaves pinnatifid, multifid or pinnatipartite.
        31. Fruit and ovary 3-locular. 25. *H. tenuifolia*
        31. Fruit and ovary 2-locular. 26. *H. brownii*

1. **Haloragis exalata** F. v. M. (Figs. 27-37)

Haloragis exalata F. v. Mueller, Trans. R. Soc. Vict. 24 (1888) 133, 134 [Typus: "Mount Dromedary (Reeder), on the Burnett River (Hely)." Lectotypus (Orchard): *Anon s.n.*, Mt. Dromedary, NSW37303 (fl.)! Syntypus: *C. Hely s.n.*, Burnett River, Queensland, MEL1003524 (fl., fr.) !]; F. v. M., Sec. Census 1 (1889) 85; Moore, Hdbk. Fl. N.S. Wales (1893) 186; Schindler, Bot. Jb. 34 Beibl. 77 (1904) 42; Schindler, Pflrch 23 (1905) 50; Dixon, Pl. N.S. Wales (1906) 129; Maid. & Betche, Census N.S. Wales Pl. (1916) 158; Skottsberg, Nat. Hist. Juan Fern. & Easter Is. 2 (1922) 153; Ewart, Fl. Vict. (1931) 883; Evans in Beadle, Evans & Carolin, Hdbk. Vasc. Pl. Syd. Dist. (1963) 175; Forde, N.Z. J. Bot. 2 (1964) 426, 448-450; Praglowski, Grana 10 (1970) 176; Beadle et al., Fl. Syd. Reg. (1972) 207; Willis, Hdbk. Pl. Vict. 2 (1972) 470.

Haloragis alata auct. non Jacquin (1781): Benth., Fl. Aust. 2 (1864) 479; F. v. M., Census 1 (1882) 49; Bailey, Qld. Fl. 2 (1900) 554; Bailey, Comp. Cat. Qld. Pl. (1913) 174.

FIGS.: Schindler, Pflrch 23 (1905) fig. 15A, B; Forde, N.Z. J. Bot. 2 (1964) fig. 16f.

Subshrub 1-1.5 m tall, stems erect, prominently 4-angled, glabrous or finely scabrous, green to reddish-purple. Leaves opposite, becoming alternate just below inflorescence, lanceolate to narrow-lanceolate, (4-) 5.5-10 cm long, 0.6-2.5 cm wide, serrate or biserrate, sessile or shortly petiolate, midrib channelled above, prominent below, glabrous, finely scabrous or with a velvety tomentum.

Inflorescence an indeterminate spike of 3-7 (-15)-flowered dichasia in the axils of alternate primary bracts. Lateral inflorescences are borne in the axils of the upper (alternate) leaves. Within each dichasium, all flowers develop to anthesis except that those of the ultimate branches may abort at an earlier stage. Primary bracts leaf-like, serrate, lanceolate, midrib$\pm$ distinct, (2-) 5-7 mm long, 0.5-1.5 (-3.0) mm wide; secondary bracts membranous, brown, linear-lanceolate, entire (0.2-) 0.4-0.5 mm long, 0.1-0.2 mm wide, deciduous; tertiary and higher order bracts minute, membranous, deciduous.

Flowers 4-merous. Sepals 4, ovate-deltoid, smooth, 0.6-0.8 mm long, 0.5 mm wide, glabrous or tomentose. Petals 4, yellow-green to reddish, hooded, (2.0-) 2.4-3.3 mm long, 0.6-0.7 mm wide (keel to margin), glabrous or tomentose. Stamens 8, filaments 0.3-0.5 mm long; anthers yellow, non-apiculate, 1.6-2.0(-2.8) mm long, 0.2-0.3 mm wide. Styles 4, hooked at tips, stigmas fimbriate, pink-purplish. Ovary green, globular to ovoid, on pedicel 0.7-1.5 mm long, 4-angled opposite petals, otherwise smooth, 0.5-0.6 mm long, 0.5-0.6 mm wide, glabrous, scabrous or velvety tomentose, ovules pendulous, 2 per locule but 1 aborts at an early stage.

Only 1-3 (-7) flowers per compound dichasium develop into fruits. Fruit ovoid to pyriform, 2.0-2.5 mm long, 1.7-2.2 mm wide, 4-ribbed opposite petals, with $\pm$ 4 grooves opposite sepals, smooth or somewhat wrinkled or irregularly transversely corrugated between ribs, 4-celled with woody endocarp and septa, and hollow columella. Sepals persistent, erect, deltoid, 0.5-1.0 mm long, 0.5-1.0 mm wide, with faint median rib. Seeds 1 to 4.

Key to subspecies of *H. exalata*

Leaves sessile, lanceolate to oblong, (4-) 6-10 cm long, 1.3-2.5 cm wide, coarsely serrate or biserrate, glabrous or finely scabrous. — subsp. *exalata*

Leaves with petiole 0.5-1.0 cm long, narrow lanceolate, 5.5-6.0 cm long, 0.6-0.8 cm wide, finely serrate or almost entire, densely velvety-tomentose. — subsp. *velutina*

subsp. **exalata**

Subshrub 1-1.5 m tall, stems glabrous or very finely scabrous, particularly on ribs. Leaves opposite, becoming alternate in inflorescence, sessile or very shortly petiolate, (and then leaf tapering abruptly into petiole), lanceolate, (4.0-) 6.0-10.0 cm long, 1.3-2.5 cm wide, broadest just below the middle, serrate or biserrate, midrib channelled above, prominent below, lateral veins faint and diverging at 20°-30° to midrib, lamina dark green above, paler below, glabrous or very finely scabrous.

Inflorescence and flowers as for species. Flowers glabrous or scabrous, 3-7 (-15) per compound dichasium, of which all except those of the ultimate branches are functional. Fruits as for species, ovoid, 2.0-2.5 mm long, 1.8-2.2 mm wide; sepals persistent, deltoid, 0.8-1.0 mm long, 0.8-1.0 mm wide, enclosing persistent styles

Key to varieties of *H. exalata* subsp. *exalata*

Stems and leaves finely scabrous — var. *exalata*

Stems and leaves glabrous — var. *laevis*

var. **exalata**

Stems and leaves finely scabrous (Figs. 28-30). Flowers glabrous except for the ovary which is scabrous (Fig. 32). Inflorescence as for the species, with 3-7 flowers per dichasium, of which only 1-2 (-3) develop into fruits. Primary bracts leaf-like, lanceolate, 5-7 mm long, 1.5-3.0 mm wide, serrate, finely scabrous, midrib distinct; secondary bracts membranous, linear-lanceolate, 0.5 mm long, 0.1 mm wide, entire, glabrous (Fig. 31). Fruit as for subspecies (Fig. 33).

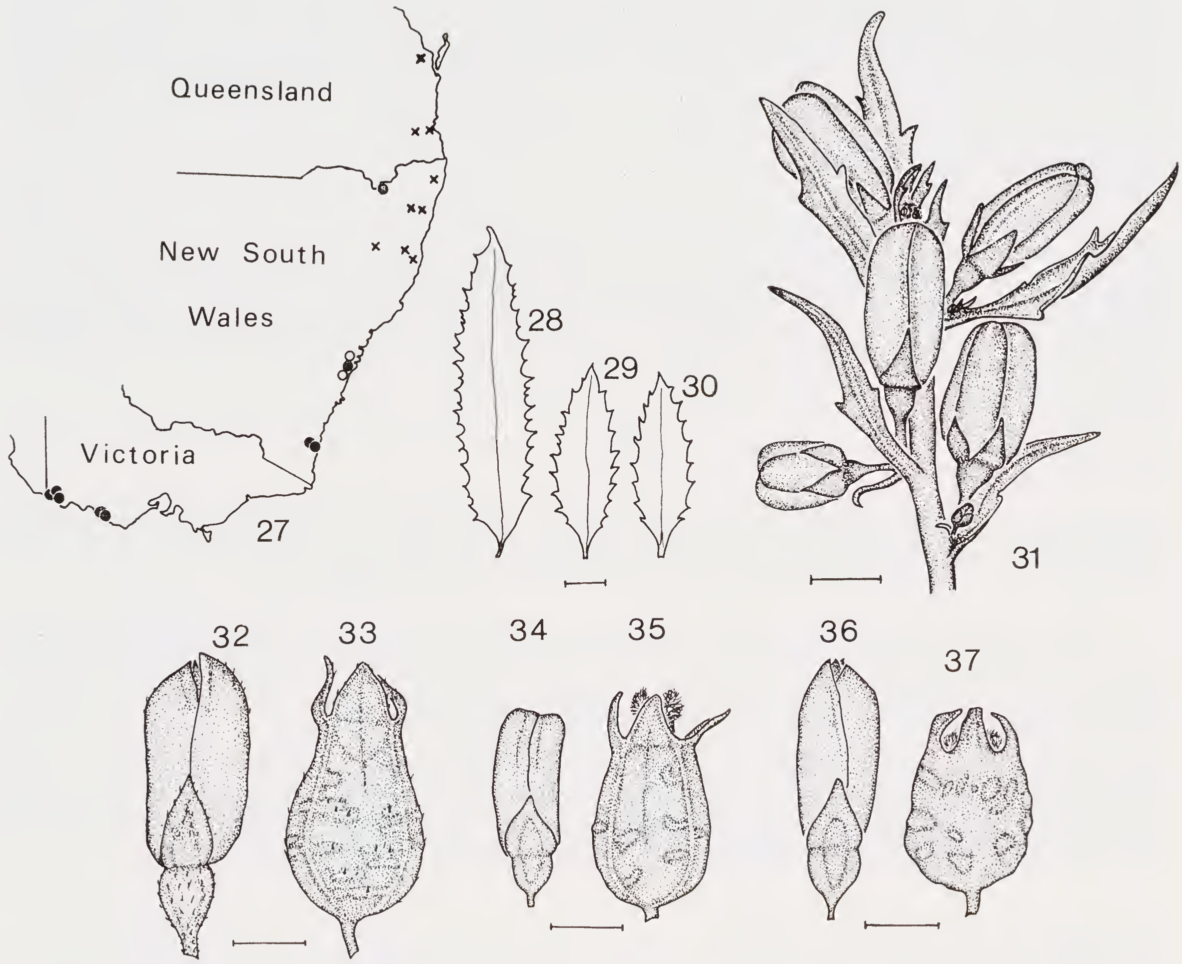
Distribution: This plant is known only from the lower reaches of the Glenelg River and Curdies Creek in south-western Victoria, and from four widely scattered localities in eastern New South Wales (Fig. 27).

Ecology: Very little is known, or recorded, except that the species as a whole appears to favour the banks or vicinity of fairly large rivers.

Common names: Wingless raspwort (*Beauglehole 457*); Square raspwort (Willis, 1972).

Specimens examined:

VICTORIA: Beauglehole 457, 25.iii.1945, -.x.1946, above Swan Lake Falls, $\pm$ 20 m. [32 km] W. of Portland, BEAUG (st.), MEL (fr.); *Beauglehole 5879,* 15.iii.1954, S. of Dartmoor, Lower Glenelg River, AD, MEL (fr.); *Beauglehole 17012,* -.x.1946, Moleside Creek, Lower Glenelg River, BEAUG (st.); *Beauglehole 17031,* 5.iii.1950,



Figs. 27-37. *Haloragis exalata.* 27. Distribution of *H. exalata* (● = var. *exalata*, ○ = var. *laevis*, × = var. *velutina*). 28-30. Leaves of *H. exalata* var. *exalata* (from *Orchard 2011*). 31. Upper portion of inflorescence of *H. exalata* var. *exalata* (from *Orchard 2011*). 32, 33. Flower and fruit of *H. exalata* var. *exalata* (32. from *Orchard 2011*; 33. from *Orchard 2014*). 34, 35. Young flower and fruit of *H. exalata* var. *laevis* (34. from *Williamson NSW99249*; 35. from *Walter NSW99248*). 36, 37. Flower and fruit of *H. exalata* subsp. *velutina* (36. from *Davis NSW99250;* 37. from *Bailey BRI080044*). Scale represents 1 cm (figs. 28-30) or 1 mm (figs. 31-37).

Swan Lake Falls, ± 20 m. [32 km] W. of Portland, BEAUG (fl., fr.); *Beauglehole & Finck 20012* (*& 21122?*), 5.ix.1966, W. side of Port Campbell Creek, BEAUG (st.); *Eckert s.n.*, 1891, Lower Glenelg River, MEL1003738 (fl.); *Gardiner s.n.*, -.i.1900, Curdies River, MEL1003529 (fr.); *Orchard 2011, 2014*, 13.ii.1969, Moleside Creek, AD, AK (fl., fr.); *Orchard 2016*, 13.ii.1969, junction of Moleside Creek and Glenelg River, AD (fr.); *Walter s.n.*, -.i.1900, Curdies River, NSW99248 (fr.); *Williamson s.n.*, 1894, Entrance of the Curdies River, MEL38933, 1003528, 1003540 (fl., fr.); *Williamson s.n.*, -.xi.1900, Curdie River, NSW99249 (fl., fr.). *NEW SOUTH WALES: Anon. s.n.*, banks of Nepean River, MEL1003525 (fl.); *Anon. s.n.*, Mt. Dromedary, NSW 37303 (fl.) — lectotype of *Haloragis exalata*; *Baeuerlen 131*, -.i.1889, Mount Dromadary [sic], MEL (fl., fr.); *Betche 5*, -.xii.1892, near Clifton, NSW (fr.); *Reader s.n.*, Tilba Tilba, MEL1003523 (fl.); *Woolls s.n.*, Nepean, MEL1003534 (st.); *Woolls s.n.*, Nepean, MEL1003539 (fl.); *Woolls s.n.*, Nepean River, NSW37302 (fl., fr.).

The choice of a lectotype was necessary because Mueller mentioned two specimens when proposing the new name for the Australian plants formerly referred to the New Zealand species *H. alata* (*H. erecta*). One of the specimens mentioned by Mueller, (*Hely*, Burnett River) can be fairly safely identified as MEL1003524, but the other (*Reeder*, Mt. Dromedary) is obscure. There is no specimen collected by Reeder in the MEL holdings and the only collection from Mt. Dromedary ['Dromadary'] is ascribed to Baeuerlen and was collected after the species had been described. In the National Herbarium of New

South Wales there is a collection annotated "Mt. Dromedary" but lacking a collector's name, number and date. This collection (NSW37303), has had the original epithet "*alata*, Jacq" crossed out, and "*exalata*, FvM", in a hand matching Mueller's, substituted. As this specimen matches Mueller's scanty description more closely than Hely's specimen, and was probably seen and annotated by Mueller, it is chosen as lectotype, and fixes the application of the name *H. exalata* to the subspecies and varietas described above. The syntype *(Hely*, Burnett River, MEL1003524) differs somewhat from the lectotype, and falls into subspecies *velutina*.

A clinal variation exists in the degree of scabridity of the leaves and stems of var. *exalata*. In south-western Victoria var. *exalata* can scarcely be distinguished visually from var. *laevis*, because of the extremely short trichomes. However, the leaves and stems are distinctly scabrous to the touch. In New South Wales, especially in the Clifton specimen, and to a lesser extent in the Nepean specimens, the trichomes are easily visible to the naked eye. This may be caused by introgression with subsp. *velutina;* the hairs in these northern specimens approach those of subsp. *velutina* in size, but not in density or texture.

var. **laevis** (Schindl.) Orchard, comb. et stat. nov.

Haloragis laevis Schindler, Pflrch 23 (1905) 51 [Typus: "Australien (Bauer) [del 673], Caley, D'Urville). — Herb. Berlin, Wien". Lectotypus (Orchard): *Ferd. Bauer, del. 673,* Nova Holland., W (fl.)! Isolectotypus: *Ferd. Bauer, del. 673,* Nova Holland., NSW99247 ex W (fl.)! Syntypi: *Caley s.n.,* Nova Hollandia, W (Hrb. Maille, Dupl. Banks) (fl., fr.)!, *D'Urville n. 1825,* NSW99246 ex B (st.)!] Praglowski, Grana 10 (1970) 176.

Stems and leaves as for var. *exalata*, but glabrous. Inflorescence as for species, with up to 15 flowers in each compound dichasium. Of these, 7-10 develop to anthesis, and up to 7 finally form fruits. Primary bracts leaf-like, lanceolate, 2.0-2.5 mm long, 0.5-0.7 mm wide, serrate, glabrous, midrib distinct; secondary bracts brown, membranous, linear-lanceolate, 0.4 mm long, 0.1-0.2 mm wide, glabrous, deciduous. Flowers completely glabrous (Fig. 34). Mature fruits not seen (Fig. 35).

Distribution: The only collections with localities indicated are those of Woolls from Paramatta and the Nepean River (near Sydney), New South Wales. D'Urville's collection was probably from the vicinity of Port Jackson (Sydney) (cf. Maiden, 1910, pp 143-144), while Caley's and Bauer's collections were probably from east-central New South Wales (cf. Currey, 1966); (Fig. 27).

Ecology: Nothing has been recorded.

Specimens examined:

NEW SOUTH WALES: Bauer 673, Nova Holland., W, NSW99247 (fl.) — lectotype and isolectotype of *H. laevis*; *Caley s.n.,* Nova Hollandia, W (fl., young fr.) — syntype of *H. laevis*; *D'Urville 1825,* s. loc. NSW99246 (st.) — syntype of *H. laevis*; *Woolls s.n.,* Nepean River, MEL1003526 (fl., young fr.); *Woolls s.n.,* Paramatta, Nepean (2 labels), MEL1003538 (fl., young fr.).

The choice of a lectotype was necessary because Schindler cited three collections in his description of *H. laevis*. The D'Urville collection in NSW is only a small fragment of the former collection in B (destroyed) and lacks flowers and fruits. The Bauer collection was preferred for the lectotype ahead of the Caley collection, as the former has a duplicate in NSW.

subsp. **velutina** Orchard, subsp. nov.

Valde similari subsp. *exalatae* sed in caulibusfoliis et floribus velutino-tomentosis differt. Folia angusto-lanceolata 5.5-6.0 cm longa 0.6-0.8 cm lata serrata dentibus deltatis 30-40, petiolus 0.5-1.0 cm longus. Bracteae primariae foliiformes lanceolatae 4.0-5.0 mm longae 0.6-1.0 mm latae integrae velutino-tomentosae; bracteae secundae membranaceae lineari-lanceolatae 0.2-0.3 mm longae 0.1-0.15 mm latae integrae velutino-tomentosae deciduae. Fructus obpyriformis 2.0 mm longus 1.7 mm latus leviter 4-costatus, rugosus.

Holotypus: *J. L. Boorman s.n.*, -.i.1907, Dalmorton, near Grafton, NSW, NSW99251 (fl.)! Isotypus: *J. L. Boorman s.n.*, -.i.1907, Dalmorton, NSW, MEL1003575 ex NSW (fl., young fr.)!

(?) *Haloragis burianum* Schindler, Fedde Rep. 9 (1911) 123 [Typus: "Neu-Süd-Wales, Kempsey (J. L. Boorman, Jan. 1907). Specimen aus dem National Herbarium of N.S.W. unter dem Namen *H. laevis* Schindler. — Herb. Berlin." Holotypus: n.v. (destroyed). Isotypi (?): *J. L. Boorman s.n.*, -.i.1907, George's Creek, via Kempsey, N.S.W., NSW 99252 (fl.)!; *J. L. Boorman s.n.*, -.i.1907, Kempsey, N.S.W., G (herb. Pitard-Briau) ex NSW (fl., young fr.)! — see below].

Stems erect, red, slightly 4-angled, covered with a fine dense velvety tomentum less than 0.01 mm long. Leaves opposite, on petiole 0.5-1.0 cm long, narrow-lanceolate, 5.5-6.0 cm long, 0.6-0.8 cm wide, widest in middle, tapering gradually towards both ends, serrate with 30-40 small teeth mainly in the upper part, or almost entire, covered on both faces by a dense velvety tomentum; midrib channelled above, ± prominent below, lateral veins very indistinct.

Inflorescence as for subsp. *exalata.* Flowers in compound dichasia of 3-7, all flowers except those of ultimate branches functional. Primary bracts leaf-like, lanceolate, 4.0-5.0 mm long, 0.6-1.0 mm wide, entire, velvety-tomentose, midrib ± distinct; secondary bracts brown, membranous, linear-lanceolate, 0.2-0.3 mm long, 0.1-0.15 mm wide, entire, velvety-tomentose, deciduous; tertiary bracts minute.

Flowers velvety-tomentose on ovary, sepals and petals, reddish, otherwise as for subsp. *exalata;* 1-3 flowers per dichasium form fruits (Fig. 36). Fruits pyriform 2.0 mm long, 1.7 mm wide, faintly 4-ribbed opposite the petals, slightly wrinkled, sepals deltoid, 0.5 mm long, 0.5 mm wide, persistent, styles reflexed between sepal lobes (Fig. 37).

Distribution: Confined to the eastern side of the Great Dividing Range, in north-eastern New South Wales and south-eastern Queensland. Where this subspecies overlaps in latitudinal range with var. *exalata* in north-eastern New South Wales, the two populations are separated by the Dividing Range (Fig. 27).

Ecology: Apparently confined to watercourses. Collectors' notes include "Swamp near Hamilton" (*Bailey* BRI080044) and "A fairly common plant growing amongst loose stones, along the course of the Macleay and Little Rivers" (*Boorman* NSW99252).

Specimens examined:

QUEENSLAND: Bailey s.n., Brisbane River, swamp near Hamilton, BRI080044 (fr.); *Hely s.n.,* Burnett River, MEL1003524 (fl., fr.) — syntype of *H. exalata*; *White s.n.,* Bunya Mts., BRI080043 (st.). *NEW SOUTH WALES: Beckler s.n.,* Clarence River, MEL1003535 (fl.); *Beckler s.n.,* Clarence River, MEL1003537 (st.); *Beckler s.n.,* Richmond River, MEL1003527 (fr.); *Boorman s.n.,* -.i.1907, Dalmorton, MEL1003575, NSW99251, (fl., fr.) — isotype, holotype of *H. exalata* subsp. *velutina*; *Boorman s.n.,* -.i.1907, George's Creek via Kempsey, NSW99252 (fl.) — ? isotype of *H. burianum* (see below); *Boorman s.n.,* -.i.1907, Kempsey, G (herb. Pitard-Briau) (fl., fr.) — ? isotype of *H. burianum* (see below); *Crawford 564,* -.iv.1885, Moona, Walcha, MEL (fl., fr.); *Davis 129,* 26.i.1941, Macleay River, NSW (fl.); *Leichardt s.n.,* Mr. Busden's, New England, MEL1003533, P (fr.).

Schindler's description of *H. burianum* matches *H. exalata* subsp. *velutina* in all respects, except that Schindler described his plant as glabrous. The holotype of *H. burianum* formerly in B (ex NSW) has been destroyed (burnt in 1943), but a specimen in NSW, and another in G, match the holotype citation and would normally be considered to be isotypes. However, these specimens, *J. L. Boorman s.n.,* -.i.1907, Georges Creek, via Kempsey, N.S.W., NSW99252 (fl.) and *J. L. Boorman s.n.,* -.i.1907, Kempsey N.S.W., G (herb. Pitard-Briau) ex NSW (fl., young fr.), have the velvety tomentum usual in *H. exalata* subsp. *velutina,* although agreeing with the description of *H. burianum* in all other respects. If it is considered that Schindler was mistaken in describing his plant as glabrous, then the specimens in NSW and G can be considered isotypes of *H. burianum* and that species is then synonymous with *H. exalata* subsp. *velutina.* If however the Boorman collection was mixed, and Schindler correctly described his plant as glabrous, then the only known collection, the holotype formerly in B, has been destroyed. In these circumstances the name cannot be typified until more material is collected from which a neotype could be selected; but even then, *H. burianum,* differing only in the lack of indumentum from *H. exalata* subsp. *velutina,* scarcely warrants specific status, and is probably best considered as a minor variant of the latter, perhaps as a variety of that subspecies.

H. exalata was cited by Bentham (1864) and Mueller (1882) as *H. alata.* This was the name then applied (incorrectly) to the New Zealand species *H. erecta.* Mueller (1888) recognised that the Australian plants differ from the New Zealand ones in characters of the fruit, leaves and primary bracts. He coined the name *H. exalata* for the former group. In this he has been followed by all subsequent workers, with the exception of Bailey, who followed Bentham.

H. exalata agrees well with *H. erecta* in general habit and in some leaf, flower, fruit and indumentum characteristics, suggesting that these two species are fairly closely related. Among the Australian species, *H. exalata* (especially subsp. *velutina*) is probably most closely allied to *H. stricta.*

2. **Haloragis stricta** R. Br. (Figs. 38-41)

Haloragis stricta R. Br. ex Bentham, Fl. Aust. 2 (1864) 482 [Typus: "Queensland. Broad Sound, R. Brown (Herb. R. Br.)" Holotypus: *R. Brown s.n.*, Broad Sound, MEL39298 ex K (fl., fr.)! Isotypi: *R. Brown s.n.*, 1802-5, Iter Australiense, LE (st.)! *R. Brown, s.n.*, Broad Sound, P (fl.)!] F. v. M., Census 1 (1882) 50, Sec. Census 1 (1889) 86; Bailey, Qld. Fl. 2 (1900) 555; Schindler, Bot. Jb. 34. Beibl. 77 (1904) 29; Schindler, Pflrch 23 (1905) 60; Bailey, Comp. Cat. Qld. Pl. (1913) 174; Praglowski, Grana 10 (1970) 182.

Figs.: Schindler, Pflrch 23 (1905) fig. 17C.

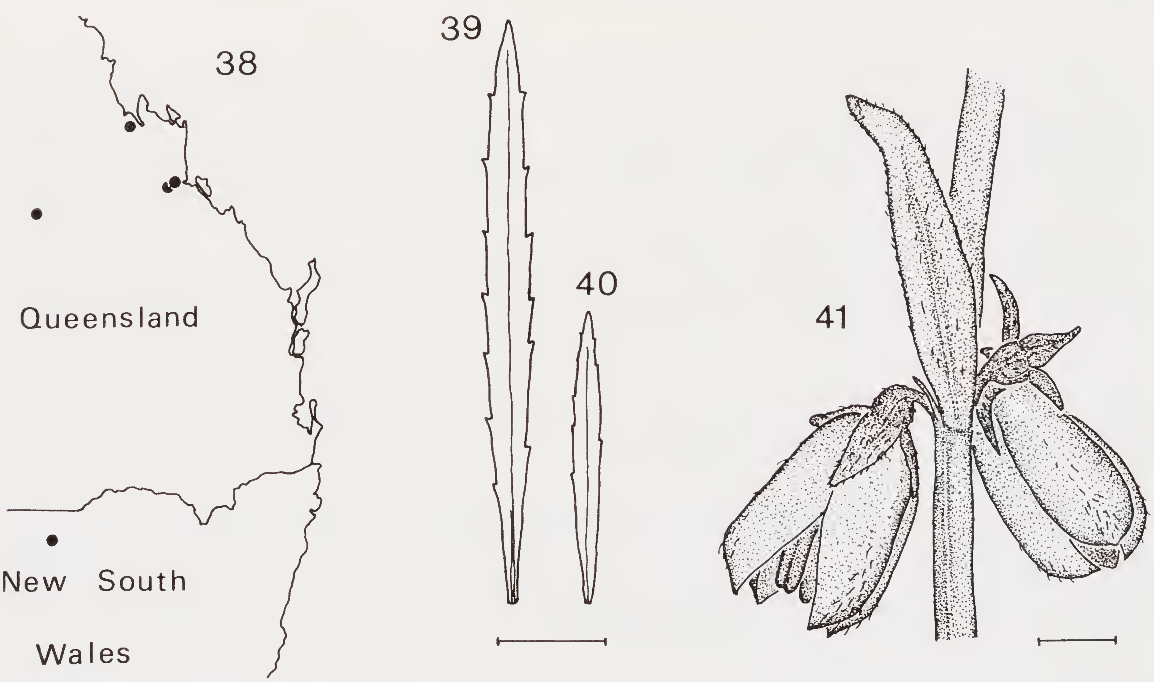
Perennial herb 25-50 cm tall, taproot ± well developed, stems erect, ± herbaceous, sparsely branched and then only at base, 4-ribbed, moderately densely scabrous with rigid, spreading, 2-3-celled, semi-transparent hairs 0.1-0.2 (-0.3) mm long.

Leaves opposite, sessile, linear-lanceolate, 2.5-4.0 (-5.0) cm long, 0.2-0.4 (-0.5) cm wide tapering gradually to base and apex, entire or finely serrate with up to 12 deltoid teeth 1 mm long, margin revolute, midrib channelled above, prominent below, lateral veins obscure, scabrous with hairs as for stems (Figs. 39, 40).

Inflorescence an indeterminate spike of 1-3 (-5)-flowered dichasia in the axils of primary bracts. Few lateral inflorescences. Primary bracts linear, 2.5-5.5 mm long, 0.4-0.9 mm wide, fleshy, entire, mid-ribbed, scabrous; secondary and tertiary bracts 0.5-0.7 (-1.0) mm long, 0.1-0.15 mm wide, brown, membranous, scabrous (Fig. 41).

Flowers 4-merous, on pedicels 0.2-0.3 mm long. Sepals 4, lanceolate, smooth, 0.6-0.9 mm long, 0.4-0.6 mm wide, lacking midrib, scabrous. Petals 4, brown, hooded, tips erect, keeled, shortly unguiculate, 2.4-3.0 mm long, 0.4-0.7 mm wide (keel to margin). scabrous on keel. Stamens 8, filaments 0.2-0.3 mm long; anthers yellow to red, oblong, 2.1-2.2 mm long, 0.3-0.4 mm wide, 4-celled, non-apiculate. Styles 4, clavate, 0.4 mm long, stigmas capitate. Ovary ovoid to hemispherical, 0.4 mm long, 0.4-0.5 mm wide, not ribbed, scabrous, 4-locular, with 1 pendulous ovule per locule.

Fruits 1-3 per axil, ovoid to globular, 2.5-2.7 mm long, 2.5 mm wide, verrucose or ± smooth. scabrous; sepals linear, 1.0 mm long, 0.5 mm wide, persistent, erect; fruit 4-locular pericarp and septa ± woody, 1-4 seeds.



Figs. 38-41. *Haloragis stricta*. 38. Distribution. 39, 40. Leaves (from *R. Brown s.n.*, P). 41. Portion of inflorescence (from *R. Brown s.n.*, P). Scale represents 1 cm (figs. 39, 40) or 1 mm (fig. 41).

DISTRIBUTION: Collection localities are scattered over a wide area of south-eastern Queensland and north-eastern New South Wales (Fig. 38).

ECOLOGY: The specimen *O'Shanesy 1250* is recorded from "wet clay soils". Flowering period is unknown, but fruiting is documented in November and March.

SPECIMENS EXAMINED:

NEW SOUTH WALES: Leichhardt s.n., 19.iii.1844, west side of the gwydir (?), MEL39029 (fr.). *QUEENSLAND: Anon. 60,* Rockhampton, MEL39026 (fr.); *Brown s.n.,* 1802-5. Broad Sound, LE, MEL, P (fl., fr.) — types of *H. stricta,* pollen sent to Palyn. Lab. Stockholm (ex P); *O'Shanesy 1250,* 1.xi.1870, Gracemere, MEL (fr.); *Wood 65,* 137, Springsure, MEL (fl., fr.).

The locality on Leichhardt's collection is almost illegible, but appears to be "gwydir". He is known to have collected at this place.

H. stricta is most closely allied to *H. exalata* subsp. *velutina* but differs in its indumentum and sessile, smaller leaves.

3. **Haloragis erecta** (Banks ex Murr.) Oken (Figs. 42-52, 53)

Haloragis erecta (Banks ex Murr.) Oken, Allg. Naturgesch. 3 (1841) 1871; Eichler, Blüthendiag. (1875) fig. 191A; Schindler, Bot. Jb. 34 Beibl. 77 (1904) 3, 42; Schindler, Pflrch 23 (1905) 49, 50; Cheeseman, Trans. N.Z. Inst. 42 (1909) 202, 203; Cockayne, Rep. Bot. Surv. Stewart Is. (1909) 57; Skottsberg, Nat. Hist. Juan Fern. & Easter Is. 1 (1922) 264, 2 (1922) 153; Cheeseman, Man. N.Z. Fl. 2 ed. (1925) 620; Allan, Trans. R. Soc. N.Z. 69 (1939) 273; Merrill, J. Arn. Arb. 31 (1950) 277; Moore, in Allan, Fl. N.Z. 1 (1961) 242; Cambie et al., N.Z. J. Sci. 4 (1961) 616; Forde, N.Z. J. Bot. 2 (1964) 425-453, Hair, N.Z. J. Bot. 4 (1966) 584; Praglowski, Grana 10 (1970) 176.

Cercodia erecta Banks ex Murray, Comm. Goett, (1780) 3-8, t. 3 [Typus: l.c., t. 3!]; DC., Prod. 3 (1828) 67; A. Cunn., Ann. Nat. Hist. 3 (1839) 29; Raoul, Choix Pl. N.Z. (1846) 48.

Tetragonia ivaefolia L.f., Suppl. (1781) 257, nom. illeg.

Haloragis ivaefolia (L.f.) Salisbury, Prod. (1796) 276.

Haloragis alata Jacquin, Misc. Austr. 2 (1781-2) 332 (n.v.) et Icon. Pl. Rar. (1783) t. 69, 1 (1781) 7, nom. illeg.; Forst., Prod. (1786) 30; Jacq., Pl. Rar. Schoenb. 1 (1798) 7; Hook. f., Fl. N.Z. 1 (1852) 62; Gray, Bot. U.S. Expl. Exped. 1 (1854) 625; Benth., Fl. Aust. 2 (1864) 479, 480, 483; Baill., Nat. Hist. Pl. 6 (1880) fig. 457-461; F.v.M., Census 1 (1882) 49; Bailey, Syn. Qld. Fl. (1883) 157:; Featon, Art Alb. N.Z. Fl. (1889) 149; Petersen, Pflfam. III 7 (1893) 230, 233; Cheeseman, Trans. N.Z. Inst. 29 (1897) 391; Kirk, Stud. Fl. N.Z. (1899) 148; Bailey, Qld. Fl. 2 (1900) 554, 555; Cheeseman, Man. N.Z. Fl. (1906) 148; Britten, J. Bot. 45 (1907) 136; Bailey, Comp. Cat. Qld. Pl. (1913) 174; Bate-Smith, J. Linn. Soc. (Bot.) 58 (1962) 148; Praglowski, Grana 10 (1970) 176.

Haloragis tetragonia L'Herit., Stirp. Nov. (1788) 82, nom. illeg.

Haloragis cercodia Dryander in Aiton, Hort. Kew 2 (1789) 37, nom. illeg.; Drake (?), in Rees, Cyclop. 16 (1811); Sprengel, Syst. Veg. 2 (1825) 260.

Cercodia alternifolia A. Cunn., Ann. Nat. Hist. 3 (1839) 29 [Typus: "New Zealand (Northern Island). Among fern, on the shores of the Bay of Islands. — 1833. R. Cunningham". Holotypus: *R. Cunningham No. 527,* 1834, New Zealand, K (fr.)!] Raoul, Choix Pl. N.Z. (1846) 48.

Haloragis alternifolia (A. Cunn.) Walp., Rep. 2 (1842) 99.

Haloragis colensoi Skottsberg, Nat. Hist. Juan Fern. & Easter Is. 2 (1922) 152, 153, 156; emend. Skottsberg, in Allan, Trans. R. Soc. N.Z. 69 (1939) 273 [Typus: "Hab. Novae Zealandiae ins. bor. (Colensoi in herb. Kew); in collibus Puketoi dictis, commun. H. H. Allan". Holotypus: *Colenso 938,* sine loc., K (fr.)!]; Allan, Trans. R. Soc. N.Z. 69 (1939) 273; Moore, in Allan, Fl. N.Z. 1 (1961) 243; Kapil, Bull. Bot. Surv. India 4 (1962) 61-63; Forde, N.Z. J. Bot. 2 (1964) 426, 427, 445-446.

FIGS: Murray, Comm. Goett. (1780) t. 3; Jacq., Icon. Pl. Rar. (1783) t. 69; Eichler, Blüthendiag. (1875) fig. 191A; Baill., Nat. Hist. Pl. 6 (1880) fig. 457-461; Petersen, Pflfam. III 7 (1893) fig. 102A; Schindler, Pflrch 23 (1905) fig. 14; Skottsberg, Nat. Hist. Juan Fern. & Easter Is. 2 (1922) fig. 17 (a-h); Moore, in Allan, Fl. N.Z. 1 (1961) fig. 11; Forde, N.Z. J. Bot. 2 (1964) fig. 1-15; Praglowski, Grana 10 (1970) pl. 6 (e-g).

Perennial herb or shrub 25-85 cm tall, stems erect, procumbent or ascending, freely branching, green to red-brown, 4-ribbed, woody at base, rooting in lower parts, glabrous, or scabrous with minute, 2-celled ± transparent hairs, with swollen basal cell, 0.05-0.1 mm long.

Leaves opposite, petiolate on petiole (0.2-) 0.8-1.0 (-3.0) cm long, broad lanceolate, ovate or orbicular, 1.5-9.0 cm long, (0.5-) 1.0-3.5 cm wide, serrate with up to 45 blunt teeth 0.5-4.0 mm long, midrib sunken above, prominent below, lateral veins ± obscure, departing at 20°-35°, glabrous, or scabrous as for stems.

Inflorescence an indeterminate spike of 3-7-flowered dichasia in the axils of alternate or subopposite primary bracts. Lateral inflorescences in axils of upper leaves. Primary bracts leaflike, lanceolate to ovate, 0.5-2.5 cm long, 0.2-1.2 cm wide, green, midribbed, ± serrate, petiolate, glabrous or scabrous; secondary bracts brown, membranous, linear, 0.5-1.2 mm long, 0.1-0.2 mm wide; tertiary bracts brown, membranous, linear, 0.3-0.6 mm long, 0.05-0.1 mm wide.

Flowers 4-merous, on pedicels 0.5-0.6 mm long. Sepals 4, deltoid, 0.8-1.2 mm long, 0.6-0.9 mm wide, ± thickened on either side at base, otherwise smooth, glabrous or scabrous. Petals 4, hooded, keeled, unguiculate, tip rounded or erect, (1.6-) 2.0-2.2 mm long, 0.6-0.7 mm wide (keel to margin), glabrous or scabrous on keel. Stamens 8, filaments 0.4 mm long; anthers yellow or red, oblong, (1.2-) 1.4-1.7 mm long, 0.3-0.5 mm wide, 4-locular, nonapiculate, antipetalous anthers 0.2 mm shorter than antisepalous ones. Styles 4, clavate, 0.4 mm long, stigmas capitate. Ovary ovoid 0.9-1.0 mm long, 0.7-1.2 mm wide, 4-winged opposite petals, 4-ribbed opposite sepals, glabrous or scabrous, 4-locular, 1 ovule per locule.

Fruits 1-3 (-5) per axil, on pedicels 0.8-1.0 mm long, obturbinate or pyriform to ovoid 1.8-3.0 mm long, 1.5-2.5 (-4.0) mm wide (including wings), rugose smooth or 4-ribbed opposite sepals, 4-ribbed or 4-deltoid-winged between sepals, glabrous, or scabrous; sepals persistent, erect, narrow deltoid, 0.9-1.7 mm long, 0.5-0.7 mm wide, not ribbed, glabrous or scabrous; fruit 4-locular, septa and pericarp woody, 1-4 seeds.

Key to subspecies of *H. erecta*

Leaves broad lanceolate to ovate, thin, upper surface dark green, lower surface light green, serrate with 20-30 (-45) teeth, (1.5-) 2.5-4.5 (-9.0) cm long, (0.5-) 1.0-3.5 cm wide, on petiole (0.5-) 0.8-1.7 (-3.0) cm long.
subsp. *erecta*

Leaves orbicular to broad ovate, thick, both surfaces grey green, upper surface drying shiny, cartilaginous, lower surface dull, serrate with 10-15 teeth, 1.5-2.2 cm long, 1.0-1.5 cm wide, on petiole 0.2-0.4 cm long.
subsp. *cartilaginea*

subsp. **erecta**

Perennial (rarely annual) herb or subshrub 30-85 cm tall, stems erect or procumbent, green to red-brown, glabrous or scabrous.

Leaves on petioles (0.5-) 0.8-1.7 (-3.0) cm long, broad lanceolate to ovate, (1.5-) 2.5-4.5 (-9.0) cm long, (0.5-) 1.0-3.5 cm wide, thin, dark green above, light green below, lateral veins well defined, serrate with 20-30 (-45) blunt deltoid teeth 1.0-2.0 (-4.0) mm long, glabrous or scabrous (Figs. 43-45).

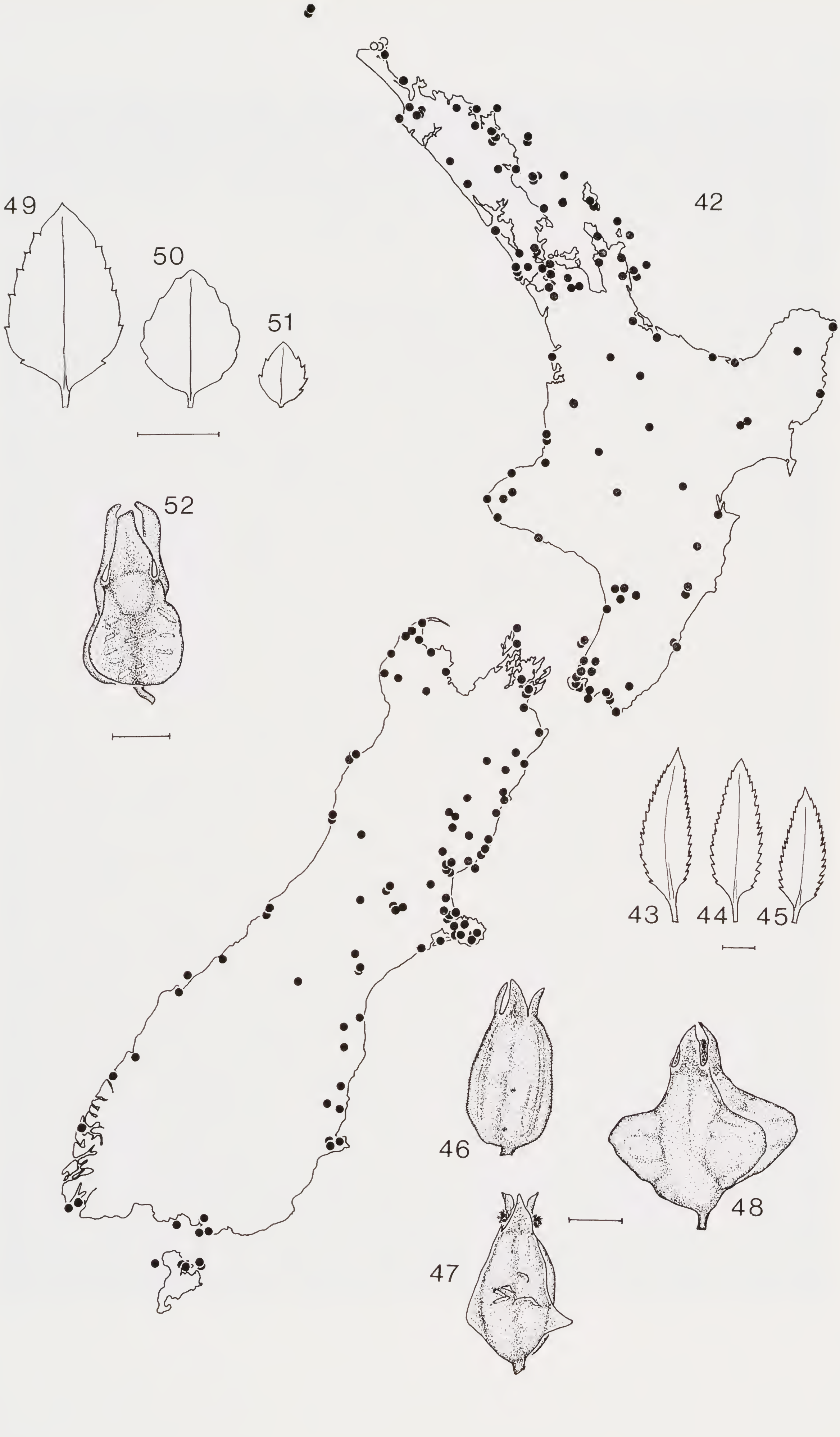
Inflorescence as for species; lateral inflorescences borne in the axils of the upper 6-8 leaves. Primary bracts ovate to lanceolate, 1.0-2.5 cm long (including petiole) 0.5-1.2 cm wide, serrate, petiolate, rapidly reduced in size, number of teeth and length of petiole towards apex, glabrous or scabrous; secondary bracts 0.5-0.8 mm long, 0.1-0.2 mm wide, tertiary bracts 0.3-0.4 mm long, 0.05-0.1 mm wide. Flowers as for species.

Fruit ovoid to pyriform, 2.0-2.3 (-3.0) mm long, 1.5-2.5 (-4.0) mm wide (including wings), 4-ribbed opposite sepals, deltoid-winged (or rarely ribbed) between sepals, ± rugose or smooth between ribs/wings, sepals 0.9-1.2 mm long, 0.5-0.7 mm wide (Figs. 46-48).

Distribution: *H. erecta* subsp. *erecta* is widespread in North, South and Stewart Islands of New Zealand, and on the Chatham and Kermadec Islands (Figs. 42, 53).

Ecology: This taxon is most common in disturbed habitats, usually in open situations, but also in dense undergrowth.. There is apparently no soil preference. Collectors' notes include "on limestone outcrop" (*Allan CHR194908*); "open country — lowland" (*Carrodus 194*); "grassy coastal vegetation" (*Fryer &*

Figs. 42-52. *Haloragis erecta.* 42. Distribution of *H. erecta,* excluding Kermadec and Chatham Islands (● = subsp. *erecta,* ○ = subsp.*cartilaginea*). 43-45. Leaves of *H. erecta* subsp. *erecta* (from *Orchard 3830*). 46-48. Fruits of *H. erecta* subsp. *erecta* (46. from *Orchard 3782,* 47. from *Orchard 3830,* 48. from *Cooper AK119867*). 49-51. Leaves of *H. erecta* subsp. *cartilaginea* (from *Cheeseman AK5919*). 52. Fruit of *H. erecta* subsp. *cartilaginea* (from *Cheeseman AK5919*). Scale represents 1 cm (figs. 43-45, 49-51) or 1 mm (figs. 46-48, 52).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Wardle CHR185622); "hillside overlooking sea" (*Hay CHR73718*); "under scrub" (*Macmillan 65/30*); "embankment at lake edge" (*Mason CHR65412*); "half prostrate in open bush" (*Moore CHR36041*); "clay bank above beach" (*Moore CHR87908*); "river bed, plants prostrate, straggling over sand bars" (*Rawson CHR97186A*); "salt marshes" (*Scott CHR87914*); "in neglected cultivated land" (*Simpson CHR29511*); "shingle banks" (*Sorenson CHR194909*). Flowering occurs from November until February, and fruiting from (November-) December until April (-August).

LOCAL NAME: Toa-toa (Maori language; Cheeseman, 1906, 1925).

SPECIMENS EXAMINED:

KERMADEC ISLANDS: Cheeseman s.n., -.viii.1887, Sunday Island, AK5914 (st.); *Sykes 497/K*, 27.xii.1966, South Meyer Island, CHR (fl., fr.); *Sykes 955/K*, 26.xi.1970, Quadrat Gully, Macauley, CHR (fl., fr.). *NORTH ISLAND: Allan s.n.*, Johnston Hill, Wellington, CHR234406 (fr.); *Allan s.n.*, 6.i.1925, Mamuku, CHR11324 (fl., fr.); *Allan s.n.*, 9.i.1932, Reef Point, CHR4348 (fl., fr.); *Allan s.n.*, -.i.1938, near Seatoun, CHR19303-6 (fl., fr.); *Allan s.n.*, 3.ii.1939, New Plymouth, CHR21779 (fr.); *Attwood s.n.*, west Ruapehu, AK100940 (fl.); *Attwood s.n.*, 1932, Maungatautari Mtn., AK100947 (st.); *Attwood s.n.*, -.x.1932, W. slope of Ruapehu, AK100944 (fl.); *Barker 69237*, 11.v.1969, Kohatuni Stn., Hawkes Bay, CANU (fr.); *Baylis s.n.*, 30.xii.1947, Great Id., Three Kings, AK24129 (fr.); *Baylis s.n.*, -.xii.1963, Great Id., Three Kings OTA009337 (fl.); *Beever 4*, 2.i.1964, Atuanui State Forest, CHR (fr.); *Bishop s.n.*, 6.xii.1965, Simmonds Island, Houhara Harbour, AK108846 (fl., fr.); *Bulmer s.n.*, -.viii.1956, New Plymouth, CHR87902 (st.); *Burke s.n.*, 24.xii.1962, Lake Waikaremoana, WELTU2659 (fl., fr.); *Carrodus 194*, -.vi.1951, Wellington, AD (fr.); *Carse s.n.*, 8.xii.1898, Maungatapere, CANTY757 (fl.); *Carse s.n.*, -.xii.1900, Te Karaka Flat, CANTY754 (fl., fr.); *Carse s.n.*, -.iv.1902, Kaiaka, CANTY759 (fl., fr.); *Carse s.n.*, -.i.1907, Kaiaka, CANTY758 (fl., fr.); *Carse s.n.*, -.iii.1907, Fairburn's, Mangonui, AK5916 (fr.); *Carse s.n.*, 2.xii.1924, Penrose, CANTY755 (fl.); *Carse s.n.*, -.i.1925, Palmerston North, CANTY 753 (fl., fr.); *Cheeseman s.n.*, -.xi.1878, Auckland Domain, AK5918 (fl.); *Cheeseman s.n.*, -.ii.1907, Mount Wellington, AK5917 (fr.); *Chinnock s.n.*, 23.i.1970, summit of Parahaki, CHR205234, WELTU9830 (fr.); *Collett s.n.*, -.viii.1964, Castlepoint, CHR153862 (st.); *Collett s.n.*, -.ix.1964, Cape Brett, CHR153769 (st.); *Collett s.n.*, -.v.1965, East Cape lighthouse, CHR183264 (fr.); *Collett s.n.*, -.viii.1965, Mokohinau Id., CHR183369 (st.); *Cooper s.n.*, 28.xi.1949, Otoroa, CHR81909 (fl.); *Cooper s.n.*, 15.i.1950, Whangatupere Bay, Three Kings Is., AK36159 (fr.); *Cooper s.n.*, 29.xi.1964, Tryphena, Great Barrier Is., AK119770 (st.); *Cooper s.n.*, 24.ii.1965, Manaia, Whangarei Heads, AK121746 (fr.); *Cooper s.n.*, 10.v.1965, Hot Springs Rd., Katikati, AK122905 (fr.); *Cooper s.n.*, 18.ii.1966, Manaia, Coromandel Co., AK126518 (fr.); *Cooper s.n.*, 18.iv.1967, 1.5 miles [2.5 km] N. of Tairua, AK127192 (fr.); *Cooper s.n.*, 22.ii.1968, Dargaville bridge, AK119867 (fr.); *Cooper s.n.*, 22.ii.1968, Waipoua Forest, AK119868, CHR213773 (fr.); *Cooper, Mason & Moar s.n.*, 2.xii.1949, near Otoroa swamp, AK35834 (fl.); *Court et al. s.n.*, 24.viii.1973, Shoe Island, off Tairua, AK133231, 133494 (st.); *Court et al. s.n.*, 19.viii.1973, Slipper Island, off Tairua, AK133116 (st.); *Cranwell s.n.*, 13-16.ii.1937, Poor Knights, AK100941, 100949, 100950, CHR21651 (fl., fr.); *Davey s.n.*, 15.xii.1938, Victoria University College, Wellington, CHR21598 (fl.); *Davey s.n.*, 18.ii.1940, Tukituki River near Waipawa, CHR175300 (fr.); *Davey s.n.*, 18.i.1945, Porirua, CHR50155 (fl., fr.); *Dawn s.n.*, 31.iii.1968, bank of Wairoa River, AK117798 (st.); *Druce s.n.*, -.xii.1960, Egmont, CHR86855 (st.); *Druce s.n.*, -.ii.1965, Paritutu Rock, CHR131535 (fr.); *Druce s.n.*, -.xii.1962, Te Reinga, CHR131882 (fl., fr.); *Druce s.n.*, -.v.1966, 5 miles [8 km] W.S.W. of Waipukurau, CHR159347 (st.); *Druce s.n.*, -.v.1966, San Hill, Pukeora, CHR159351 (fr.); *Druce s.n.*, 4.iii.1970, Hallett's Bay, L. Taupo, CHR197433 (fl., fr.); *Druce s.n.*, -.xii.1971, Taita, CHR246448 (fl.); *Druce s.n.*, -.i.1972, Te Waka Ra., CHR246340 (st.); *Druce s.n.*, -.i.1972, Taita, CHR246404 (fr.); *Dumbleton s.n.*, -.ii.1967, Paihia, CHR174863 (fr.); *Edwards 55*, 20.iii.1970, Animaniwa, Lake Waikaremoana, AK, BISH (fr.); *Findlay s.n.*, 7.iv.1956, Pongaroa, CHR87910 (fr.); *Findlay s.n.*, 8.iv.1956, Mangatainoka, CHR87911 (fr.); *Forde s.n.*, -.v.1955, Green's Stream, Orongorongo Valley, CHR87776 (st.); *Fryer s.n.*, 16.iv.1963, Kitekite track, Piha, CHR144114 (fr.); *Fryer s.n.*, 1.i.1964, Anawhata, CHR152566 (fl.); *Gilham s.n.*, -.viii.1957, Mokohinau Islands, CHR111601 (fr.); *Gordon 94*, 29.xii.1957, Lion Rock, Castlepoint, WELTU (fl.); *Goulding 287*, 16.xi.1971, Ihumatao, AK (fl.); *Hair s.n.*, 26.v.1955, Lower Pouaki Range, CHR87643 (st.); *Hamilton s.n.*, 13.i.1956, Little Barrier Island, CHR87432-3 (fr.); *Hamlin s.n.*, 26.iii.1948, Gollan's Valley, Wellington, CHR62057 (fr.); *Hay s.n.*, 8.xii.1949, Pukerua Bay, CHR73718 (fl.); *Hay s.n.*, 15.iii.1952, Waitarangi Stream, Palliser Bay, CHR76963 (fr.); *Healy s.n.*, 21.xii.1940, Evans Bay, CHR33201 fl., fr.); *Healy s.n.*, 10.iv.1941, Titahi Bay, Wellington, CHR234407 (fl., fr.); *Healy s.n.*, 26.xii.1942, Rangitikei River, Rewa, CHR36247 (fl., fr.); *Hombron s.n.*, 1841, Bay of Islands, P (fl., fr.); *Hynes s.n.*, -.xi.1952, Auckland, U31912B (fl., fr.); *Hynes s.n.*, 27.viii.1964, Motu Muka Island, AK103797 (st.); *Hynes s.n.*, 19.ii.1970, Rose Bay, Lake Waikaremoana, AK122593 (st.); *Kelly s.n.*, -.iv.1967, Waitiki, N. Cape, CHR178149 (st.); *Kirk s.n.*, Auckland, WELT42645, 42646 (fl.); *Kirk s.n.*, Wellington, OTA015939, WELT42647-8 (fr.); *Latta s.n.*, Puketoi Hills, CHR175299 (fr.); *Lush s.n.*, 1948, Piha, WELT42680 (fr.); *Lynch s.n.*, 24.viii.1971, Red Mercury Is., AK128807 (st.); *MacMillan 69/95*, 13.iii.1969, Woodhill, CHR (fr.); *MacMillan 69/165*, 16.iii.1969, 5 miles [8 km] N. of Moumoukai, CHR (fr.); *Mason s.n.*, 6.iv.1939, Breaker Bay, CHR22541-52 (fl., fr.); *Mason s.n.*, 6.iv.1939, Botanic Gardens, Wellington, CHR22871 (st.); *Mason s.n.*, 10.xii.1939, Eastbourne, CHR23294, 23995 (fl.); *Mason 1384*, 15.iii.1952, Palliser Bay, CHR (fl., fr.); *Mason 4208*, 12.i.1946, swamp south of Manutaki, CHR (fl., fr.); *Mason 7662, 7663*, 10.xii.1959, S. end Tauranga Harbour, CHR (fl.); *Matthews s.n.*, -.ii.1907, Kaitaia, AK5915 (fl., fr.); *McQueen s.n.*, -.viii.1947, Kapiti, WELT (st.); *Meebold 4799*, -.vi.1929, Manawatu Gorge, M (fr.); *Meebold 4937*, Mokopeka, M (st.); *Meebold 18234*, -.iv.1933, Orakei, M (fl., fr.); *Mellor s.n.*, -.i.1956, Mt. Manaia, WELT 6904 (fr.); *Moar 499*, 28.i.1950, Muriwai, CHR (fr.); *Moar 539*, 1.ii.1950, Lake Kawakatai, CHR (fl., fr.); *Moore s.n.*, 12.iii.1939, Cape Turakirae, CHR22403-4 (fl., fr.); *Moore s.n.*, 18.iii.1939, Breaker Bay, CHR22246-7 (fr.); *Moore s.n.*, 20.iii.1939, Lower Akatarawa Valley, CHR22248 (fr.); *Moore s.n.*, 7.v.1939, Corner Creek, Palliser Bay, CHR23006 (fr.); *Moore s.n.*, 6.vi.1939, Taumarunui, CHR23007 (fr.); *Moore s.n.*, 30.xii.1941, Little Barrier Island, CHR234186 (fl., fr.); *Moore s.n.*, 29.viii.1942, Johnson's Hill, Karori, CHR36041 (fr.); *Moore s.n.*, 28.xii.1943, Martin's Falls, Warkworth, CHR44578 (fl., fr.); *Moore s.n.*, 1.iv.1944, Paekakariki Hill, Wellington, CHR44623 (fr.); *Moore s.n.*, -.vii.1952, Little Barrier Is., CHR78471 (st.); *Moore s.n.*, 7.iii.1954, Cape Palliser, CHR87188 (fl., fr.); *Moore s.n.*, -.xii.1954, Totara Reserve, Pohangina, CHR87919, 87924-5 (fl.);

Moore s.n., 26.xii.1954, Mt. Messenger, CHR87599 (fl.); *Moore s.n.,* 26.xii.1954, Awakino, CHR87920 (fl., fr.); *Moore s.n.,* 26.xii.1954, Mt. Messenger, CHR87922 (fl.) — pollen sent to Palyn. Lab., Stockholm; *Moore s.n.,* 26.xii.1954, Tainui anchor, Mokau, CHR87923 (fl.); *Moore s.n.,* 31.xii.1954, Cape Egmont, CHR87921 (fl., fr.); *Moore s.n.,* 16.i.1955, Titahi Bay, CHR87778-9 (fr.); *Moore s.n.,* 5.ii.1955, Johnston's Hill, Karori, CHR87780 (fl., fr.); *Moore s.n.,* 8.ii.1955, Martin's Falls, Warkworth, CHR87770 (fr.); *Moore s.n.,* 1.iv.1955, Pt. Halswell, CHR97099 (fr.); *Moore s.n.,* 3.iv.1955, Akatarawa Valley, CHR87785 (fr.); *Moore s.n.,* 10.vii.1955, Silverdale, CHR87771 (st.); *Moore s.n.,* 3.ix.1955, Pukeora Sanatorium, CHR87765-6 (st.); *Moore s.n.,* 4.ix.1955, Puketapu, CHR87767-9 (st.); *Moore s.n.,* 5.ix.1955, Konini, CHR87933 (st.); *Moore s.n.,* 1.vi.1956, Henderson Valley Road, CHR97101 (st.); *Moore s.n.,* 8.ii.1965, Cook's Cove, Tolaga Bay, CHR141259 (fl., fr.); *Moore s.n.,* 22.viii.1972, Great Barrier Is., CHR232967 (st.); *Moore & Cranwell s.n.,* 30.iii.1932, above Opope, Hikurangi, AK100945 (fr.); *Moore & Cranwell s.n.,* 15.xi.1933, Taranga Is., AK100946 (fl.); *Oliver s.n.,* 26.xii.1919, Mt. Karioi, WELT 6896 (fl., fr.); *Oliver s.n.,* 1.xii.1924, Poor Knights Is., WELT35344 (fl.); *Oliver s.n.,* 4.xii.1924, Poor Knights Is., WELT35371 (fl., fr.); *Oliver s.n.,* -.iii.1931, Breaker Bay, WELT42688 (fl., fr.); *Oliver s.n.,* 24.ii.1934, Poor Knights, WELT42683 (fr.); *Oliver s.n.,* 25.ii.1934, Chicken Is., WELT42684 (st.); *Oliver s.n.,* -.i.1935, Kapiti, WELT6892 (fr.); *Oliver s.n.,* 31.xii.1935, Seatoun, WELT6903 (fl., fr.); *Oliver s.n.,* 9.ii.1949, Waitomo, WELT6866 (fr.); *Orchard 3386,* 20.vii.1972, Huia Valley, AK (st.); *Orchard 3408,* 2.viii.1972, Mercer Bay, AK (st.); *Orchard 3430,* 21.viii.1972, Glen Innes Domain, AK (st.); *Orchard 3453,* 1.x.1972, Dingle Dell reserve, St. Heliers, AK (st.); *Orchard 3481,* 9.x.1972, Opito Bay, nr. Kerikeri, AK (st.); *Orchard 3608,* 14.x.1972, Soda Springs, Maungataniwha Range, AK (st.); *Orchard 3674,* 29.xi.1972, ca 1.5 km S.W. Oakura Bay, AD, AK NSW (fl , fr.); *Orchard 3719,* 29.xi.1972, ca 4 km W. of Mokau Bay, AK (fl., fr.); *Orchard 3782,* 30.xi.1972, ca 4.5 km S E. of Waikare, AD, AK, BH, DAV (fl., fr.); *Orchard 3830,* 1.xii.1972, Ohawini Bay, AK (fl., fr.); *Orchard 3869,* 1.xii.1972, N. end Mokau Bay, AD, AK, CHR, K, MO (fl., fr.); *Orchard 3887,* 30.xii.1972, Martinborough-Hinakura road, AD, AK (fl., fr.); *Orchard 3944,* 10.iii.1973, ca 5 km east of Coromandel, AD, AK (fl., fr.); *Parris s.n.,* 18.xii.1966, Goat Island, near Leigh, AK128880 (fl.); *Parris s.n.,* 7.ii.1968, Whatapuke Is., AK123209 (fr.); *Parris s.n.,* 7.ii.1968, Burgess Is., AK122799 (fr.); *Parris s.n.,* 16.ii.1968, Goat Island, Leigh, AK129052 (fr.); *Parris s.n.,* 25.viii.1968, Radar Hut, Cuvier Is., AK119632 (st.); *Parris & Keen s.n.,* 21.xi.1966, Spragg's Bush, AK110745 (st.); *Petrie s.n.,* -.iii.1889, Waipawa, WELT42651 (fl., fr.); *Petrie s.n.,* -.ii.1896, Whakatane, WELT42652 (fr.); *Petrie s.n.,* 1914, Mt. St. John, CANTY725, WELT42658-9 (fl., fr.); *Petrie s.n.,* -.xii.1916, Epsom, CANTY756, WELT42655 (fl.); *Petrie s.n.,* -.xii.1922, Mt. St. John, WELT42656-7 (fr.); *Phillips Turner 228,* Wellington Heads, AK (st.); *Potts s.n.,* 11.xii.1954, Opotiki, WELTU2651 (fl., fr.); *Potts s.n.,* 25.iii.1955, Opotiki, CHR87931-2 (fl., fr.); *Pritchard s.n.,* Manawatu Gorge, CHR87926-30 (fr.); *Pritchard s.n.,* 11.iv.1955, Sinclair Head, CHR87912, 87915-6 (st.); *Pritchard s.n.,* 11.iv.1955, Tongue Point, CHR 87934 (fr.); *Pritchard s.n.,* 11.iv.1955, Karori Stream, CHR87938-9 (fr.); *Pritchard s.n.,* -.v.1955, Green's Stream, Orongorongo Valley, CHR87775 (st.); *Pycroft s.n.,* -.i.1932, Poor Knights Is., AK100948 (fl.); *Pycroft s.n.,* -.iv.1933, Taranga Is., AK100951 (st.); *Ritchie & Ritchie s.n.,* 26.x.1968, Coppermine Is., CHR186909 (st.); *Ritchie & Ritchie s.n.,* 27.x.1968, Whatapuke Is., CHR186908 (st.); *Sibson s.n.,* -.ix.1959, Alderman Is., CHR76035 (st.); *Sneddon s.n.,* 9.xii.1967, Tolaga Bay, WELTU7153 (fl., fr.); *Smart s.n.,* 20.i.1965, Pukekohe, CHR154074 (fr.); *Travers s.n.,* -.xi.1908, Wellington, M (fl., fr.); *Turbott s.n.,* 6.x.1948, Three Kings Is., AK26670 (st.); *t'Woudt s.n.,* Kapiti Is., WELTU2649 (st.); *t'Woudt s.n.,* -.i.1948, Kennedy Bay, WELTU2650 (fr.); *Zotov s.n.,* 1931, Palmerston North, CHR4529 (fl., fr.); *Zotov s.n.,* -.iii.1937, Hataitai, CHR18349 (fl., fr.); *Zotov s.n.,* 27.iii.1945, Castlepoint, CHR51217 (fl., fr.); *Zotov s.n.,* 15-17.i.1953, Pukerua Bay, CHR80768, 80770 (fr.). *SOUTH ISLAND: Aitken s.n.,* 20.ii.1955, Portobello Marine Station, CHR87764 (fl., fr.); *Allan s.n.,* Lynn Valley, Mt. Peel, CHR11354 (fr.); *Allan s.n.,* 19.xii.1940, Port Hills, CHR146879-80 (fl.); *Allan* s.n., 29.i.1941, Limestone Ra, near Waikari, CHR87094, 194908, 234196-8 (fr.); *Allan s.n.,* 16.iii.1941, Point Elizabeth, CHR87095 (fr.); *Allan s.n.,* 30.i.1946, Chalky Inlet, CHR234122 (fl.); *Armstrong s.n., Mt.* Pleasant, CANTY (fr.); *Armstrong s.n.,* Christchurch, CHR234405 (fl., fr.); *Aston s.n.,* -.xii.1915, Dee Valley, WELT42653 (fl., fr.); *Bannister s.n.,* -.ii.1952, Golden Bay Power House, Takaka, CHR92539 (fl., fr.); *Barker 699,* 6.i.1969, Half Moon Bay, Stewart Is., CANU (fl.); *Barker 68196,* 8.xii.1968, Okuku, CANU (fl.); *Barker 69167,* 5.iv.1969, Lake Brunner, CANU (fr.); *Barker 69255,* 25.x.1969, Oaro, CANU (st.); *Boyce s.n.,* 11.vii.1954, Akaroa, CHR88496 (st.); *Burrows s.n.,* -.i.1957, Woodstock, CANU3174 (fl.); *Burrows s.n.,* -.i.1958, Oaro, CANU3172 (fl.); *Burrows s.n.,* -.i.1958, lower Broken R., CANU3179 (fl., fr.); *Burrows s.n.,* -.xii.1960, Marble Point, Waiau R., CANU3123 (fl.); *Burrows s.n.,* -.xi.1963, Kaikoura, CANU6904 (st.); *Burrows s.n.,* -.i.1964, Waiho, CANU6916 (st.); *Burrows s.n.,* -.iv.1970, Open Bay Island, CANU14362 (st.); *Campbell s.n.,* -.xi.1964, Middle Trio Island, WELTU8779 (fl., fr.); *Collett s.n.,* -.iv.1965, Kahurangi Point, CHR177503-4 (fr.); *Cragg s.n.,* 22-28.iii.1973, Chalky Island, CHR247604 (st.); *Dawson s.n.,* 2.xii.1953, Trio Islands, CHR234194, WELTU 8778 (fl.); *Dobson s.n.,* 5.xii.1970, Coutts Is., CANU14290 (fl.); *Dobson s.n.,* 15.viii.1971, nr. Waipara Gorge, CANU015403 (st.); *Druce s.n.,* -.xi.1971, Kekerengu, CHR245224 (fl.); *Dumbleton s.n.,* 14.xii.1965, Jackson's Bay, CHR166398 (st.); *Filhol s.n.,* 1875, Invercargill, P (fl., fr.); *Fineran s.n.,* 6.iii.1965, Codfish Is., S.W. Stewart Is., CANU8482 (fr.); *Fineran s.n.,* 9.iii.1965, Bird Is., CANU8728, 8730-1 (fr.); *Fryer & Wardle s.n.,* 23.vii.1968, Okarito Bluff, CHR185622 (st.); *Gillham s.n.,* -.i.1957, Portobello, CHR111432 (fl., fr.); *Gillham s.n.,* 11.ii.1957, Old Mill Creek, Stewart Is., CHR111456 (fr.); *Hair s.n.,* 26.v.1955, Hanmer, CHR87620 (st.); *Hair s.n.,* 26.v.1955, Trotters Gorge, Palmerston South, CHR87644 (st.); *Harris s.n.,* 2.iii.1949, Big Bay, CHR73207 (fr.); *Hay s.n.,* 14.iv.1952, Tasman Range, CHR76990 (fr.); *Healy s.n.,* 23.v.1941, Jed River, Gore Bay, CHR35235 (fr.); *Healy s.n.,* 25.v.1941, Gore Bay, near Cheviot, CHR33602 (terat.); *Healy s.n.,* 15.v.1943, Weka Creek, Weka Pass, CHR25275 (fr.); *Healy s.n.,* 18.xii.1943, Kaiwarra River, Glen Muick, CHR41398 (fl., fr.); *Healy s.n.,* 1.ii.1944, Blythe River, Kilmarnock Downs, CHR234195 (fr.); *Healy s.n.,* 20.ii.1945, betw. Lake Forsyth & Lake Ellesmere, CHR51007 (fl., fr.); *Healy s.n.,* 1.v.1945, Otaio R., near Mt. Blythe, CHR51339 (fr.); *Healy s.n.,* 19.iv.1955, Glenrock Station, upper Rakaia River, CHR89788 (fl., fr.); *Healy 54/234,* 28.viii.1954, Horse Range Road, nr. Palmerston South, CHR (st.); *Healy 54/544,* 8.xii.1954, Waipara River, CHR (fr.); *Healy 55/76,* 24.i.1955, summit of Port Hills above Governor's Bay, CHR (fr.); *Helms s.n.,* 1882-83, Greymouth, M, P (fl., fr.); *Hombron s.n.,* 1841, Akaroa, P (fr.); *Hynes* s.n., 6.ii.1963, Oban, Halfmoon Bay, Stewart Is., AK92056 (fl., fr.); *Hynes s.n.,* 28.i.1965, Jack's Pass, AK104619 (fr.); *Johnson s.n.,* 23.ii.1970, Lake Paringa, OTA028223 (fl., fr.); *Kelly s.n.,* 20.vii.1971, Peraki Saddle scenic reserve, CHR178323 (fr.); *Kirk s.n.,* Canterbury Plains, WELT42649 (fr.); *Kirk s.n.,* Nelson, AD, CGE (fl.); *Lambrechtsen s.n.,* 23.iii.1968, Birch View near Coalgate, CHR182011 (fr.); *Le Guillou s.n.,* 1841, Akaroa, P (fr.); *Le Guillou 9,* 1841, Otago, P (fr.);

Perennial shrub 25-30 cm tall, stems ascending or procumbent, dark red, otherwise as for species, scabrous.

Leaves on petioles 0.2-0.4 cm long, orbicular to broad ovate, 1.5-2.2 cm long, 1.0-1.5 cm wide, glabrous, thick, grey-green on both surfaces, upper surface drying shiny and cartilaginous, lower surface dull, lateral veins obscured, margin ± thickened, shortly and bluntly serrate with 10-15 deltoid teeth 0.5-1.0 mm long (Figs. 49-51).

Inflorescence as for species; lateral inflorescences few. Primary bracts ovate, 0.5-1.0 cm long, 0.2-0.6 cm wide, serrate, petiolate, becoming lanceolate, ± entire, sessile in upper part; secondary bracts 0.8-1.2 mm long, 0.15-0.2 mm wide, tertiary bracts 0.4-0.6 mm long, 0.1 mm wide. Flowers as for species.

Fruit obturbinate to ovoid, 1.8-2.0 mm long, 1.8-2.0 (-2.5) mm wide (including wings), not ribbed opposite sepals, thickly 4-deltoid-winged between sepals, rugose between wings, scabrous, sepals (1.0-) 1.5-1.7 mm long, 0.6-0.7 mm wide (Fig. 52).

DISTRIBUTION: This subspecies is confined to the North Cape Peninsula, at the northern extremity of North Island, New Zealand (Fig. 42).

ECOLOGY: *H. erecta* subsp. *cartilaginea* is found in exposed places in low heathy cliff-top scrub at an altitude of 100-250 m. Collectors' notes include "near cliff top in open pohutukawa [*Metrosideros excelsa*] dominated forest" (*Baylis OTA01809*); "clifftop scrub — fairly plentiful" (*Baylis OTA001808*); "rocky scree, serpentine" (*Burke WELTU8030*); "sheltered hollow in cliff" (*Cooper AK24460*); "procumbent with other low plants in rocky ground at top of cliffs" (*Gordon WELTU2640*); "scrub on serpentine belt" (*Kalin 67301*); "cliff face" (*Powell AK50384*). Flowering takes place from November until January, and fruiting from November until April. Forde (1964) reported that this taxon "is known only from a small strip of coast near North Cape where it is found in dwarf scrub on dry coastal bluffs." Through crossings with *H. erecta* from other parts of the country, she was able to demonstrate a partial reproductive barrier between '*H. cartilaginea*' and *H. erecta*.

SPECIMENS EXAMINED:

NORTH ISLAND: Adams s.n., N. Cape, AK100942 (fr.); *Baylis s.n.*, 11.xii.1934, North Cape, CHR18171, OTA001809 (fl.) — pollen sent to Palyn. Lab. Stockholm; *Baylis s.n.*, 8.i.1953, North Cape, OTA001808 (fl., fr.); *Beddie s.n.*, -.vi.1944, North Cape District, CHR46412 (st.); *Burke s.n.*, 5.xii.1963, Kerr Point, WELTU8030 (fl., fr.); *Carse & Matthews s.n.*, -.xii.1926, North Cape, CANTY760 (fl., fr.); *Cheeseman s.n.*, -.i.1896, North Cape, AK5919 (fr.) — holotype of *H. cartilaginea*; *Cooper s.n.*, 22.iii.1949, Kerr's Point, North Cape, AK24460 (fr.); *Druce s.n.*, -.i.1969, -.iii.1969, cult. Taita, ex North Cape, CHR221435, 221436 (fl., fr.); *Finlayson s.n.*, -.vi.1944, North Cape, CHR185368 (st.); *Gordon s.n.*, 9.i.1966, Kerr Point, WELTU2640 (fl., fr.); *Hynes s.n.*, 24.viii.1957, Kerr Point, North Cape, AK50813 (st.); *Kalin 67301*, 5.ii.1967, Kerr Point, North Cape, CANU (fr.); *Kelly s.n.*, -.iv.1967, 1 mile [2 km] east of Kerr Pt. trig. CHR178170, 178181 (fr.); *Matthews & Carse s.n.*, -.xii.1926, near North Cape, AK100939 (fl., fr.); *Moore & Mitchie s.n.*, 1.i.1954, Kerr Point, CHR83657 (fl., fr.); *Oliver s.n.*, 24-29.xi.1916, North Cape Peninsula, WELT6902, 42654, 42671, WELTU2637 (fl.); *Parris s.n.*, 26.x.1969, Kerr Point, AK128001 (st.); *Potts s.n.*, 15.v.1960, cult. ex Kerr Point, CHR76034 (fl.); *Powell s.n.*, 26.i.1950, Kerr Point, AK50384 (fr.); *Silvester s.n.*, -.xii.1963, near Cape Reinga, CANU9666 (st.).

The study by Forde (1964) on the *H. erecta* complex in New Zealand helps considerably in understanding the nature of the variation that can be observed in this and in other polymorphic species of *Haloragis*. Her concepts of the species limits and relationships are substantially maintained in this study. Her large series of collections, made under the name Ashwin, and housed in CHR, has been re-examined and annotated, but to save space, has not been listed above.

H. erecta very closely resembles the Juan Fernandez species *H. masafuerana* and *H. masatierrana* and can be distinguished from them only on a combination of characters. *H. erecta* is also closely related to the Australian species *H. exalata*, from which it differs mainly in its smaller, petiolate leaves and ± winged fruits. From *H. stokesii*, its only other close relative, it is distinct in its 4-locular ovary, 8 stamens and short-peduncled dichasia.

All specimens so far collected of this subspecies come from the herb fields of the Kerr Point-North Cape region. The collection *Silvester CANU9666* also came from this area, not from Cape Reinga, as stated on the label (Silvester, pers. comm.).

4. **Haloragis masafuerana** Skottsberg (Figs. 53, 54)

Haloragis masafuerana Skottsberg, Nat. Hist. Juan Fern. & Easter Is. 2 (1922) 156, fig. 20 [Typus: "Masafuera: Germain, oct. 1854 (Herb. Santiago!); Q. de las Vacas, on the walls of the outer section (fr. 10/2 17, no. 441 f. tuberculata); stony beach near Varadero (fr. 22/2 17, no. 1216); Q. de la Loberia, near the shore (fr. 17/2 17

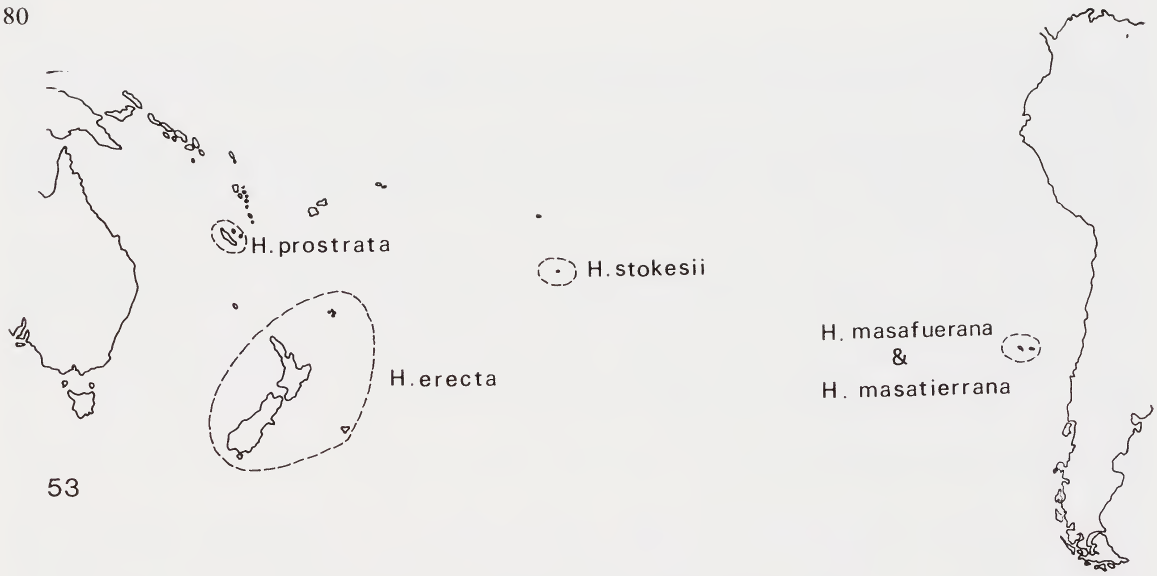


Fig. 53. Distribution of the Pacific species of *Haloragis.*

no. 485 — f. alulata)." Lectotypus (Orchard): *Carl o. Inga Skottsberg 1216,* 22.ii.1917, Juan Fernandez: Masafuera, shore near entrance to Quebr. de Varadero, S, n.v.; Isolectotypi: l.c., BISH!, HBG!, P!, UPS! (fl., fr.) Syntypi: *Carl o. Inga Skottsberg 441,* 10.ii.1917, Juan Fernandez: Masafuera, Quebrada de las Vacas, S (fr.)!; *Carl o. Inga Skottsberg 485,* 17.ii.1917, Juan Fernandez: Masafuera, Loberia, S (fr.)!]; Allan, Trans. R. Soc. N.Z. 69 (1939) 273; Moore, in Allan, Fl. N.Z. 1 (1961) 243; Forde, N.Z. J. Bot. 2 (1964) 426, 450, 452; Praglowski, Grana 10 (1970) 178.

Figs.: Skottsberg, Nat. Hist. Juan Fern. & Easter Is. 2 (1922) figs. 18, 20; Forde, N.Z. J. Bot. 2 (1964) fig. 16 (g-o), 17; Praglowski, Grana 10 (1970) pl. 6 (h-m).

Perennial herb 25-40 cm tall, stems erect, freely branched, red-brown, 4-ribbed, or almost smooth, glabrous, or scabrous with short, spreading 2-3-celled hairs with swollen bases, tapering rapidly to very sharp points, 0.1-0.2 (-0.3) mm long, opaque.

Leaves opposite, petiolate, petiole 0.5-1.8 cm long, lamina broad lanceolate to ovate 1.5-6.0 cm long, 0.8-1.5 (-2.5) cm wide; bright green above, dull light green below, midrib sunken above, prominent below, lateral veins depart at 35°-45°, serrate with 15-25 deltoid teeth 0.1-0.2 cm long, glabrous, or scabrous on margins, ± upper and lower surfaces with hairs as for stems.

Inflorescence an indeterminate spike of 1-3 (-5)-flowered dichasia in the axils of alternate primary bracts. Lateral inflorescences few, in axils of upper leaves. Primary bracts lanceolate to narrow ovate, 1.0-3.0 (-4.0 cm long, 0.3-1.0 cm wide, leaflike, green, fleshy, petiolate, serrate, glabrous or scabrous; secondary bracts 0.6-1.0 mm long, 0.1-2.0 mm wide, brown, membranous, linear; tertiary bracts as for secondary bracts, 0.5-0.7 mm long, 0.1 mm wide.

Flowers 4-merous, on pedicels 0.4-0.7 mm long. Sepals 4, deltoid to ovate, 0.6-0.8 (-1.1) mm long, 0.6-0.8 mm wide, green, not ribbed, glabrous or scabrous. Petals 4, (1.8-) 2.2-2.3 (-3.0) mm long, 0.5-0.7 mm wide (keel to margin), yellow-green to reddish, hooded, tip erect, keeled, unguiculate, glabrous, or scabrous on keel. Stamens 8, filaments 0.3-0.4 ı m long; anthers yellow, oblong, (1.1-) 1.4-1.6 (-2.1) mm long, 0.3-0.4 mm wide, 4-celled, nonapiculate, antipetalous anthers ca 0.2 mm shorter than antisepalous ones. Styles 4, clavate, 0.4 mm long, stigmas capitate. Ovary globose to ovoid, 1.2-1.3 mm long, 1.1-1.3 mm wide, strongly 4-ribbed opposite petals, weakly 4-ribbed opposite sepals, 4-locular with 1 ovule per locule.

Fruits 1-3 per axil on pedicels (0.7-) 1.0-3.0 mm long, globose to ovoid or pyriform, verrucose, tuberculose or smooth, weakly 8-ribbed, or ribs between sepals converted to small deltoid or oblong membranous wings; sepals persistent, erect, deltoid, 0.8-1.0 (-1.2) mm long, 0.6-1.2 mm wide, fruit 4-locular, septa and pericarp woody, 1-4 seeds (Fig. 54).

Key to varieties of *H. masafuerana*

Glabrous plant; fruit usually lacking wings, 3.0-4.0 mm long, 2.8-3.3 mm wide.	var. *masafuerana*
Scabrous plant; fruit usually winged, 1.8-2.0 mm long, 2.0-3.0 mm wide.	var. *asperrima*

var. **masafuerana**

Glabrous plant, 25-30 cm tall. Leaves ovate to narrow ovate, 1.5-3.5 cm long, 0.8-1.5 cm wide, bright green above, dull green below, on a petiole 0.5-1.0 cm long.

54

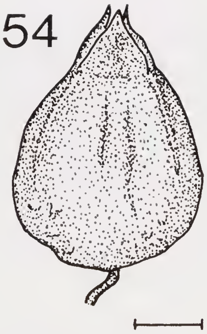


Fig. 54. Fruit of *Haloragis masafuerana* (from *Skottsberg 1216*). Scale represents 1 mm.

Dichasia 1-3-flowered; primary bracts lanceolate, 1.0-1.4 (-2.0) cm long, 0.4-0.5 cm wide, secondary bracts 0.6 mm long, 0.2 mm wide. Flowers 4-merous on pedicels 0.5-0.7 mm long, flowers as for species; sepals 4, deltoid to ovate, not ribbed; petals hooded, keeled, glabrous; stamens 8, anthers 4-celled, oblong, nonapiculate; styles 4, clavate, ovary ovoid, 8-ribbed.

Fruits 1-3 per axil, on pedicels 3 mm long, ovoid to globose, 3.0-4.0 mm long, 2.8-3.3 mm wide, verrucose or tuberculose, very weakly 8-ribbed or rarely weakly and irregularly winged between sepals; sepals 0.9-1.0 mm long, 1.0-1.2 mm wide.

Distribution: Confined to the island of Masafuera (Fig. 53). Reports of this species from the mainland of South America are almost certainly in error.

Ecology: The collection *Skottsberg 1260* was collected on the shore. Flowering is recorded from December until February, and fruiting in the latter month only.

Specimens examined:

MASAFUERA: Bertero 1041, -.xii.1829, ex Insula Juan Fernandez, M (fl.); *G. & I. Skottsberg 441,* 10.ii.1917, Quebrada de las Vacas, S (fr.) — syntype of *H. masafuerana; C. & I. Skottsberg 485,* 17.ii.1917, Loberia, S (fr.) — syntype of *H. masafuerana*; *C. & I. Skottsberg 1216,* 22.ii.1917, Quebr. de Varadero, BISH, HBG, P, UPS (fl., fr.) — isolectotypes of *H. masafuerana. CHILE* (?): *Dessauer s.n.,* 1869, Quajardo Mendoza, M (fl., fr.).

var. **asperrima** (Skottsberg) Orchard, comb. et stat. nov.

Haloragis asperrima Skottsberg, Nat. Hist. Juan Fern. & Easter Is. 2 (1922) 153-154, fig. 18 [Typus: "Masafuera: Skottsberg 1908, ster. — Q. de las Casas, quite common (fl., fr. 11/2 17, no. 457 — f. fructibus alatis); Q. de las Vacas (fl., fr. 10/2 17, no. 442 — f. non alata); Q. del Blindado, in the forest c. 440 m; Q. del Varadero; on the precipice above Buque Varado, c. 1200 m." Lectotypus (Orchard): *Carl o. Inga Skottsberg 457,* 11.ii.1917, Juan Fernandez; Masafuera, Quebrado de las Casas, S (fr.)! Isolectotypi: BISH!, HBG!, K!, P!, UPS! Syntypus: *Carl o. Inga Skottsberg 442,* 10.ii.1917, Juan Fernandez: Masafuera, Quebrada de las Vacas, S (fr.)!]; Allan, Trans. R. Soc. N.Z. 69 (1939) 273; Kapil, Bull. Bot. Surv. India 4 (1962) 61; Forde, N.Z. J. Bot. 2 (1964) 426, 448, 450, 452.

Figs: Skottsberg Nat. Hist. J. Fern. & Easter Is. 2 (1922) fig. 18; Forde, N.Z. J. Bot. 2 (1964) fig. 16 (g-o), 17.

Scabrous plant up to 38 cm tall, leaves broad 12) fig. 18; Forde, N.Z. J. Bot. 2 (1964) fig. 16 (g-o), 17. (-2.5) cm wide, dark green above, light green below, on a petiole 0.7-1.8 cm long.

Dichasia 1-3 (-5)-flowered; primary bracts lanceolate to narrow-ovate, 1.0-3.0 (-4.0) cm long, 0.3-1.0 cm wide; secondary bracts (0.6-) 0.8-1.0 mm long, 0.1-0.2 mm wide; tertiary bracts 0.5-0.7 mm long, 0.1 mm wide. Flowers 4-merous, on pedicels 0.4-0.6 mm long; sepals, petals etc as for species.

Fruits 1-3 per axil, on pedicels 0.7-1.0 mm long, ovoid to pyriform, 1.8-2.0 mm long, 2.0-3.0 mm wide (including wings), 4-ribbed opposite sepals, 4-ribbed or -winged between sepals, wings membranous, deltoid or oblong, near base of fruit, scabrous; sepals 0.8 mm long, 0.6-0.8 mm wide.

Distribution: Confined to the island of Masafuera (Fig. 53).

Ecology: Collectors' notes include "in the forest c. 440 m." (Skottsberg — Q. del Blindado); "on the precipice above Buque Varado, c. 1200 m." (*Skottsberg*); "dry outer slopes" (*Skottsberg 457*). Flowers and fruits are both plentiful on collections made in February.

SPECIMENS EXAMINED:

MASAFUERA: C. & I. Skottsberg 442, 10.ii.1917, Quebrada de las Vacas, S (fr.) — syntype of *H. asperrima; C. & I. Skottsberg 457,* 11.ii.1917, Quebrada de las Casas, BISH, HBG, K, P, S, UPS (fl., fr.) — lecto- and isolectotypes of *H. asperrima*; *Solbrig et al. 3776,* 5.xii.1965, Quebrada Casas, GH (fl.). *CULTIVATED: Ashwin s.n.,* grown from seed sent by Professor Skottsberg from Masafuera, CHR (st.).

The choice of a lectotype for the name *H. masafuerana* was necessary as Skottsberg cited 4 different collections with his description. Skottsberg's number 1216 was chosen because Skottsberg described the flowers of the species and this was the only collection cited by him with flowers.

Similarly, the name *H. asperrima* required lectotypification, and Skottsberg's number 457 was chosen because duplicates exist in at least 5 other herbaria.

On the basis of present collections, var. *asperrima* and var. *masafuerana* can be easily distinguished from each other and from *H. masatierrana.* However, when further collections have been made, it may be found necessary to include all three taxa in a single species.

The affinities of *H. masafuerana* are with *H. masatierrana.* These two species, as suggested by Forde (1964), are closely related to the New Zealand species *H. erecta*, and can be separated from it only on a combination of characters, rather than on any particular difference.

5. **Haloragis masatierrana** Skottsberg (Fig. 53)

Haloragis masatierrana Skottsberg, Nat. Hist. J. Fern. & Easter Is. 2 (1922) 155, fig. 19 [Typus: "Not rare on the dry rocky ridges, also on open, stony ground n the forest belt. Rabanal (Johow); El Pangal, on the western slope: C. Centinela (Johow); V. Colonial, C. Central (also Johow), 570 m (fl. -fr. 18/1 17, no. 304), Q. del Monte Maderugo, roadside in the macal, 240 m, and rocky wall, 390 m; C. Salispuedes, frequent, 350-650 m (fl. 20/12 16, no. 172); Portezuelo de Villagra, not rare on both sides (fl. 3/12 16, no. 34 also observed by Johow); ridge between Vaqueria and Q. Juanango, 300 m; Q. Juanango, outer part. South side of the island. Q. Villagra, rare in the forest c. 500 m; east side of B. Chupones, barren slopes." Lectotypus (Orchard): *Carl o. Inga Skottsberg 34,* 3.xii.1916, Juan Fernandez: Masatierra, Portezuelo de Villagra, a "ruggarna tia"; 590 m., S (fl., fr.)! Isolectotypus: *Carl o. Inga Skottsberg 34,* 3.xii.1916, Juan Fernandez: Masatierra, Portezuelo de Villagra, 540 m., UPS (fl., fr.); Syntypi: *Carl o. Inga Skottsberg 172,* 20.xii.1916, Cordon Salsipuedo, BISH (fl.); *Carl o. Inga Skottsberg 304,* 18.i.1917, Juan Fernandez: Masatierra, Vahe Colonial, Cordon Central; 570 m, HBG, UPS (fl., fr.)]; Allan, Trans. R. Soc. N.Z. 69 (1939) 273; Moore, in Allan, Fl. N.Z. 1 (1961) 243; Forde, N.Z. J. Bot. 2 (1964) 426, 450, 452; Praglowski, Grana 10 (1970) 178.

FIGS: Skottsberg, Nat. Hist. J. Fern. & Easter Is. 2 (1922) fig. 19; Forde, N.Z. J. Bot. 2 (1964) fig. 16 (a-e), 18; Praglowski, Grana 10 (1970) pl. 7 (a-b).

Perennial shrub 30-100 cm tall, stems erect, freely branched, woody near base, red-brown, 4-ribbed, glabrous.

Leaves opposite, petiolate, on petiole (0.4-) 0.6-1.0 (-1.2) cm long; ovate, (1.0-) 1.5-2.7 cm long, (0.5-) 0.7-1.5 (-1.7) cm wide, lamina dark green above, light green below, serrate with (12-) 15-25 teeth 0.5-1.0 mm long, midrib sunken above, prominent below, lateral veins ± obscure, departing at 20°-30° to midrib, glabrous.

Inflorescence an indeterminate spike of 1-3 (-7) flowered dichasia in the axils of primary bracts. Lateral inflorescences absent or borne in the axils of the upper 4-8 leaves. Primary bracts lanceolate to ovate, (0.3-) 0.5-0.9 cm long, 0.1-0.4 cm wide, leaflike, green, fleshy, serrate, shortly petiolate, midribbed, glabrous; secondary bracts linear, 0.5-0.7 mm long, 0.1-0.3 mm wide, membranous, red-brown, deciduous at an early stage, tertiary bracts as for secondary bracts, 0.3-0.5 mm long, 0.1 mm wide, deciduous.

Flowers 4-merous on pedicels 0.5-1.0 mm long. Sepals 4, ovate, 0.9-1.1 mm long, 0.8-0.9 mm wide, red, midribbed. Petals 4, 2.5-2.8 mm long, 0.8 mm wide (keel to margin), red to yellow, hooded, tip erect, ± non-unguiculate, keeled, glabrous. Stamens 8, filaments 0.2-0.3 mm long; anthers linear-oblong, 1.9-2.3 mm long, 0.3-0.4 mm wide, yellow, 4-celled, nonapiculate, antipetalous anthers ca 0.1 mm shorter than antisepalous ones. Styles 4, clavate, 0.4-0.5 mm long, stigmas capitate. Ovary obovoid, 1.0-1.2 mm long, 0.8-0.9 mm wide, 8-ribbed, glabrous, 4-locular with 1 ovule per locule.

Fruits 1-3 per axil, on pedicels 1.0-1.7 mm long, ovoid, (2.4-) 2.5-3.0 mm long, (1.8-) 2.0-2.4 mm wide, smooth, not winged or ribbed, glabrous; sepals persistent, erect, oblong to ovate, 1.2-1.3 mm long, 0.9-1.0 mm wide, not ribbed, glabrous; fruit 4-locular, septa and pericarp ± woody, 1-4 seeds.

DISTRIBUTION: This species is confined to Masatierra, in the Juan Fernandez group of islands (Fig. 53).

ECOLOGY: According to Skottsberg (1922), *H. masatierrana* is fairly common on dry, rocky ridges and on open stony ground in the forest belt. Flowering occurs in (October-) December-January, and fruiting from December to January.

SPECIMENS EXAMINED:

MASATIERRA: Bertero s.n., Ile de Juan Fernandez, P (fl., fr.); *Bertero s.n.*, 1830, Juan Fernandez, GH (fl., fr.); *Bertero 1041*, -.x.1829, Ins. Juan Fernandez, P (fl., fr.); *Cuming 1347, Juan Fernandez, CGE (fl., fr.); Gay s.n.*, 1833, I. Juan Fernandez, P (fr.); *Skottsberg & Skottsberg 34*, 3.xii.1916, Portezuelo de Villagra, S, UPS (fl., fr.) — lecto- & isolectotypes of *H. masatierrana*; *Skottsberg & Skottsberg 172*, 20.xii.1916, Cordon Salsipuedo, BISH (fl.) — syntype of *H. masatierrana*; *Skottsberg & Skottsberg 304*, 18.i.1917, Vahe Colonial, HBG, UPS (fl., fr.) — syntype of *H. masatierrana; Solbrig et al. 3836*, 11.xii.1965, Pangal, GH (fl., fr.); *Solbrig et al. 3891*, 20.xii.1965, Portezuelo de Camote, GH (fl). *CULTIVATED: Ashwin s.n.*, 9.i.1958, cult. Lower Hutt, New Zealand, from seed sent by Skottsberg, CHR (fl., fr.).

The choice of a lectotype was necessary as Skottsberg listed a number of specimens with his description, without particular mention of any one of them. The specimen chosen was favoured because it was the only specimen seen from Herb. S, where Skottsberg's main collection is housed.

Because of the few specimens available, it is difficult to determine the true status of this species. It is certainly very closely allied to *H. masafuerana*, and with the collection of further material, the two species may have to be amalgamated.

The very close resemblance between the two Juan Fernandez species and *H. erecta* of New Zealand suggests that the former are possibly fairly recent introductions. It is not impossible to suppose that chance introduction of a few seeds of an unusual form of *H. erecta* to the Juan Fernandez group from New Zealand by early voyagers (whalers, sealers) could have given rise to the present populations of *H. masafuerana* and *H. masatierrana*. Forde (1964) commented on the similarities and differences of the three species, but because of cultural problems was unable to test for genetic reproductive barriers between the New Zealand and Juan Fernandez plants.

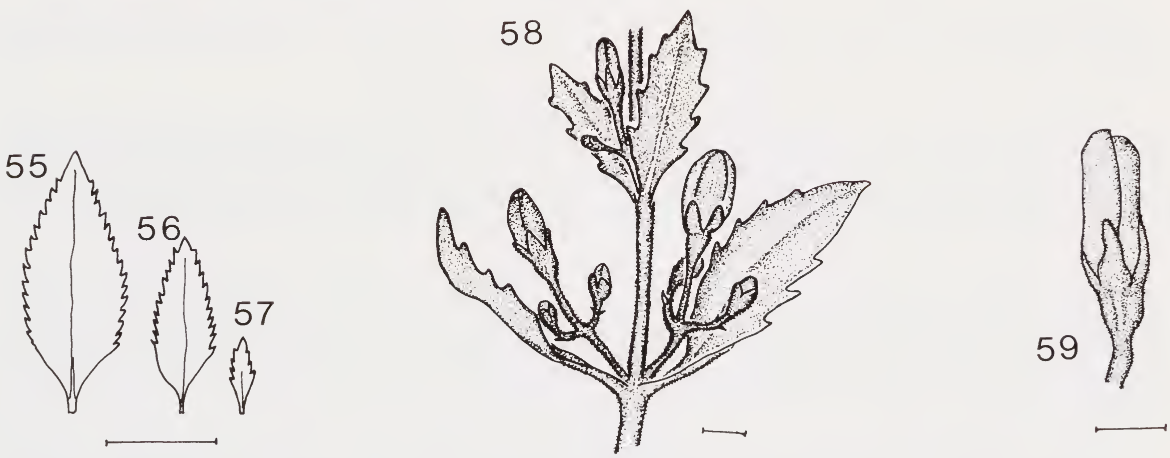
6. **Haloragis stokesii** F. Br. (Figs. 53, 55-59)

Haloragis stokesii F. Brown, Bull. Bish. Mus. 130 (1935) 205 [Typus: "Rapa, Tavaitau, altitude 225 meters, January 2, 1922, Stokes no. 440". Holotypus: *A. M. Stokes 440*, 2.i.1922, Ta Vaitau, el. 750 ft? Bush 4 ft high; flower creamy yellow, BISH (2 sheets) (fl.)!]

FIGS.: Brown, Bull. Bish. Mus. 130 (1935) fig. 29.

Perennial herb or subshrub to 1.3 m tall, stems erect, red-purple, strongly 4-angled, at least on younger parts, densely puberulous with 1-celled transparent hairs less than 0.05 mm long; hairs on older stems confined to angles or absent. Leaves decussate, broad-lanceolate, 1.5-2.0 cm long, 0.7-1.0 cm wide, serrate with 20-30 deltoid teeth ca 1 mm long, petiole 2-3 mm long, lamina dark green above, paler below, midrib sunken above, prominent below, lateral veins obscure, apex acute, base tapering abruptly to petiole, densely pilose on both faces with hairs as for stems (Figs. 55-57).

Inflorescence a determinate spike of 3-7 (-15) flowered dichasia borne in axils of decussate primary bracts. Lateral inflorescences arise in axils of many of upper leaves. Dichasia borne on slender peduncles 2 mm long; flowers of ultimate branching usually abortive. Primary bracts leaflike, green, fleshy, midribbed, lanceolate, 6-10 mm long, 1-3 mm wide, serrate with 4-6 teeth or almost entire, puberulous. Secondary bracts submembranous, linear-lanceolate, ca 0.5 mm long, densely puberulous, deciduous. Tertiary bracts as for secondary, but 0.1-0.2 mm long (Fig. 58).



Figs. 55-59. *Haloragis stokesii*. 55-57. Leaves. 58. Portion of inflorescence. 59. Bud. (All from *Stokes 440*). Scale represents 1 cm (figs. 55-57) or 1 mm (figs. 58, 59).

Flowers 4-merous, on pedicels up to 1.5 mm long (Fig. 59). Sepals 4, green, narrow deltoid, 0.8-0.9 mm long, 0.5 mm wide, tip acuminate, margin submembranous, outer surface puberulous. Petals 4, yellow, hooded, 1.8-1.9 mm long, 0.4 mm wide (keel to margin), weakly keeled, non-unguiculate, glabrous or very sparsely scabrous on tip. Stamens 4, antipetalous, filaments 0.1-0.2 mm long; anthers yellow, linear-oblong, 1.5 mm long, 0.3 mm wide, 4-celled, nonapiculate. Styles 2, antisepalous, clavate, 0.4 mm long, stigmas fimbriate. Ovary narrowly turbinate, flattened in plane of styles, 0.8 mm long, 0.5-0.6 mm wide (across widest diam.), weakly ribbed opposite sepals, puberulous; 2-locular, 1 ovule per locule. Mature fruit not seen.

DISTRIBUTION: This species is known only from the type locality of Rapa Island (Fig. 53).

ECOLOGY: Very little has been recorded. The type specimen came from an altitude of 225 m, and was flowering in early January.

SPECIMENS EXAMINED:

RAPA: Stokes 440, 2.i.1922, Ta Vaitua, BISH (fl.) — Holotype of *H. stokesii.*

On one of the type sheets there is a packet containing five mature fruits. These are 4-locular with small deltoid wings between the sepals. As both of the specimens making up the type are only in bud, with a few flowers at anthesis, it is unlikely that these fruits belong to the specimen. They are almost certainly of *Haloragis erecta.* The fruits described by Brown are very immature, and consist of the ovary just after anthesis and the shedding of the petals. The flowers of *H. stokesii* seem to have a consistently 2-locular ovary.

Superficially *H. stokesii* resembles *H. erecta,* and the type was so determined by Caspers for Flora Malesiana, but *H. stokesii* is distinct in its 2-locular ovary, 4 stamens, fine puberulent indumentum and long-peduncled dichasia.

7. **Haloragis prostrata** Forst. & Forst. f. (Figs. 53, 60,61)

Haloragis prostrata Forst. & Forst. f., Char. Gen. Pl. (1775) 62 [Typus: "Botanices insula" (in Forst., Prod.). Lectotypus (Orchard): In Botanices ins. ad Novam Caledoniam leg. Forster, Dr. & Forster, GOET (fl., fr.)! Syntypus: *Forster s.n.,* Hab. in Botanices insula, LE ex herb. Fischer (fl., fr.)! Syntypi (?): *Anon s.n.,* Bot. Isle, N. Caledonia, LE (fr.)!; *J. R. Forster s.n.,* Nova Caledonia, S (fr.)!; *Forster 78,* Nova Caledonia, M (fr.)!; *Anon. 67, Botanices Insula prope Novam Caledoniam,* W137655 ex Reichenbach fil. (fl., fr.)!; *Forster s.n.,* Nova Caled., W ex herb Jacq. (fl. fr.)!]; Forster, Fl. Ins. Aust. Prod. (1786) 30; L'Herit., Stirp. Nov. (1788) 82; Drake (?) in Rees, Cyclop. 16 (1811); Sprengel (ed.), Syst. veg. 2 (1825) 261; DC., Prod. 3 (1828) 67; Schindler, Pflrch 23 (1905) 48; Guillaumin, Ann. Mus. Coll. Marseilles, II, 9 (1911) 141; Guillaumin, Fl. Nouv. Cal. (1948) 249; Praglowski, Grana 10 (1970) 176.

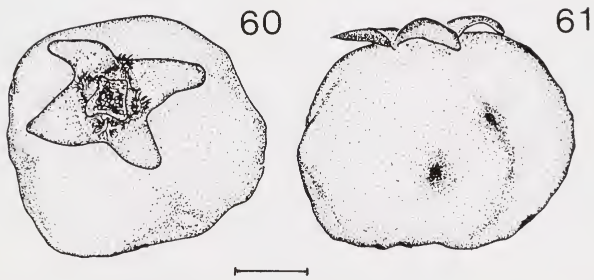
FIGS.: Forst. & Forst. f., Char. Gen. Pl. (1776) pl. 31; Praglowski, Grana 10 (1970) pl. 6 (a-d).

Prostrate glabrous herb, stems reddish, $\pm$ 4-angled, 15-20 (-35) cm long, leaves opposite, spathulate, 1.5-2.0 (-3.0) cm long, 0.5-0.6 (-0.8) cm wide, entire or crenulate, apiculate, $\pm$ sessile or shortly (1-2 mm) petiolate, midrib sunken above, prominent below, lateral veins indistinct.

Inflorescence an indeterminate spike of 3-flowered dichasia in the axils of primary bracts. All flowers capable of developing to fruit. Primary bracts opposite in lower parts, becoming alternate and reduced in upper parts, green, fleshy, spathulate-oblanceolate, 0.7-1.0 (-1.5) cm long, 0.2-0.4 cm wide, entire, apiculate, midrib apparent; secondary bracts membranous, linear-lanceolate, 1.0 mm long, 0.2 mm wide, lacking midrib; tertiary bracts membranous, linear-lanceolate, 0.5-0.7 mm long, 0.1-0.2 mm wide.

Flowers green, 4-merous, on pedicel 0.7-1.0 mm long, peduncle minute. Sepals 4, deltoid, 0.8-1.0 mm long, 0.5-0.7 mm wide, lacking midrib. Petals 4, green to yellowish, hooded, keeled, shortly unguiculate, tip not hooked, 1.5-1.8 mm long, 0.6-0.7 mm wide (keel to margin). Stamens 8, filaments 0.2 mm long; anthers yellow, 4-locular, oblong, 0.9-1.0 mm long, 0.3 mm wide, non-apiculate, equisized. Styles 4, clavate, 0.5 mm long, stigmas fimbriate, red to yellow. Ovary orbicular, 1.2-1.5 mm diameter, not ribbed, 4-locular, with 1 pendulous ovule per locule.

Up to 2 fruits per dichasium mature. Fruit globular, 2.3-3.0 mm long, 2.6-4.0 mm wide, very slightly 4-angled between the sepals, exocarp spongy, endocarp woody; sepals persistent, deltoid, 0.9 mm long, 0.8 mm wide, midribbed, spreading; 1 seed potentially able to develop in each locule (Figs 60, 61).



Figs. 60, 61. Fruits of *Haloragis prostrata* (from *Vieillard s.n.,* NY). Scale represents 1 mm.

DISTRIBUTION: This species is found only in the New Caledonia group of islands, where it has been collected only rarely (Fig. 53).

ECOLOGY: *H. prostrata* apparently only grows on sandy beaches. As the type species of the genus, this habitat preference, combined with its large rounded fruits, inspired the name *Haloragis* (literally: "sea-berry"). Collectors' notes include "sables maritim" (*Lemee 2283*) and "prostrate plant . . . on beach" (*McKee 7889*). Flowering and fruiting occurs in December-January, but is not well documented.

SPECIMENS EXAMINED:

NEW CALEDONIA: Anon. s.n., Bot. Isle, N. Caledonia, LE (fr.) — ? syntype of *H. prostrata*; *Anon. 67,* Botanices Insula prope Novam Caledoniam, W (fl., fr.) — ? syntype of *H. prostrata*; *Forster s.n.,* 1779, in Botanices insula, LE (fl., fr.) — syntype of *H. prostrata*; *Forster s.n.,* Nova Caled. W (fl., fr.) — ? syntype of *H. prostrata*; *Forster 78,* Nova Caledonia, M (fr.) — ? syntype of *H. prostrata*; *Forster & Forster s.n.,* in Botanices ins. ad Novam Caledoniam, GOET (fl., fr.) — lectotype of *H. prostrata*; *Lemee 2283,* 1928, Isle St. Marie, BRI (fl.); *McKee 7889,* 1.i.1961, Tanghene, CANB (fl., fr.); *Vieillard 2974,* 1861-67, Tono, LE, NY (fr.).

All the specimens examined are uniform morphologically, with the exception of *Lemee 2283* which is much more robust than the others (leaves 3.0 cm long, 0.8 cm wide, stems 35 cm long). However, although the flowers in this specimen are only young buds, there seems little doubt that it belongs to *H. prostrata.*

Forster (1775) did not cite any particular specimen that could serve as type, but in 1786, he gave "Botanices insula" as the locality for *H. prostrata.* Only one collection amongst those examined is definitely attributed both to Forster and the locality Botanices insula, and this specimen (in GOET) is therefore nominated here as lectotype. Several other collections, cited above as "? syntype", can be attributed to Forster, or else came from the type locality. Morphologically, there is no reason to doubt that they are indeed genuine syntypes. A further specimen in this category, but not examined for this study, is listed by Hiepko (1969) as being in Herb. Willdenow (B).

The relationships of this species are obscure, but probably lie with the *H. erecta-H. exalata* group.

The plant "*Haloragis littoralis*" Forst. ex Guillaumin (1911), *nom. nud.* probably belongs here, but I have seen no specimens.

8. **Haloragis serra** Brongn. (Fig. 62)

Haloragis serra Brongniart in Duperrey, Voy. Coq. Bot. (1829-1834) t. 69 [Typus: loc. cit. t. 69!]; A. Gray, Bot. U.S. Expl. Exped. 1 (1854) 625; Benth., Fl. Aust. 2 (1864) 479, 482, 483; F. v. M. Census 1 (1882) 49; F. v. M., Trans. R. Soc. Vict. 24 (1888) 134; F. v. M., Sec. Census 1 (1889) 85; Moore, Hdbk. Fl. N.S. Wales (1893) 186; Petersen, Pflfam. III. 7 (1893) 232; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 24, 30; Schindler, Pflrch 23 (1905) 52, 53; Maiden & Betche, Census, N.S. Wales Pl. (1916) 158; Praglowski, Grana 10 (1970) 178.

FIG.: Brongniart, in Duperrey, Voy. Coq. Bot. (1829-1834) t. 69.

Erect perennial herb or small shrub 40-60 (-90) cm tall, rootstock stoloniferous, stems branching freely, strongly 4-ribbed, green to red-brown, woody, scabrous (particularly on ribs) with curved 2-3-celled translucent hairs (basal cell ± swollen) 0.1-0.2 mm long.

Leaves opposite, sessile, lanceolate to narrow lanceolate, (2.5-) 3.0-5.0 (-6.0) cm long, 0.6-1.0 cm wide, apex acute, serrate with 10-30 teeth 0.1-0.2 mm long, midrib channelled above, prominent below, lateral veins obscure, glabrous, or scabrous on margins and midrib with hairs as for stems.

Inflorescence an indeterminate spike of 1-3-flowered dichasia in the axils of alternate primary bracts. Lateral inflorescences arise in the axils of the upper 4-6 (-8) leaves. Primary bracts leaflike, green,

fleshy, linear-lanceolate, 0.5-1.0 (-1.5) cm long, 0.1-0.3 cm wide, serrate or entire, scabrous; secondary bracts, brown, membranous, linear, 0.4-0.5 mm long, 0.1-0.2 mm wide, prominent midrib; tertiary bracts brown, membranous, linear, 0.2-0.3 mm long, 0.1 mm wide.

Flowers tetramerous, on pedicel 0.8-1.0 mm long. Sepals 4, ovate-deltoid, 0.7-0.8 mm long, 0.6-0.7 mm wide, green, not ribbed, glabrous. Petals 4, yellow to green, hooded, tips erect, keeled, unguiculate, (2.4-) 2.8-2.9 mm long, 0.6-0.9 mm wide (keel to margin), scabrous on keel or glabrous. Stamens 8, filaments 0.2 mm long; anthers yellow, oblong, (1.8-) 2.1-2.3 mm long, 0.4 mm wide, 4-celled, nonapiculate. Styles 2, clavate, 0.5 mm long, stigmas capitate. Ovary oblong 0.9-1.0 mm long, 0.5-0.7 mm wide, tapering to base, furrowed between styles, protuberant opposite styles, somewhat flattened in plane of styles, 2-locular with 1 pendulous ovule per locule.

Fruits 1-3 per axil, on pedicels 0.8-1.0 mm long, oblong-ovoid, 2.0-3.3 mm long, 1.3-1.7 mm wide, slightly contracted in upper half, weakly 4-ribbed between sepals, ± rugose in lower half, compressed in plane of styles, glabrous; sepals persistent, erect, deltoid, 0.7-0.9 mm long, 0.6-0.7 mm wide, not ribbed; 2-locular, pericarp and septum sub-woody, seeds 1 or 2.

Distribution: *H. serra* is known only from eastern New South Wales, where it has been collected mainly on the lower western slopes of the Great Dividing Range between 300-600 m altitude, although a few collections are known from the adjacent plains (Fig. 62).

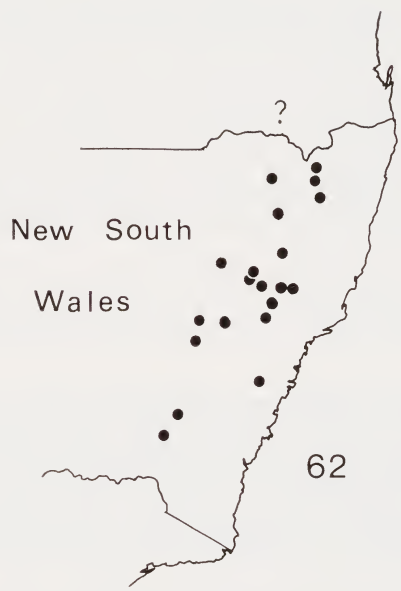


Fig. 62. Distribution of *Haloragis serra*.

Ecology: This species is found over a wide range of soils and vegetation types. Collectors' notes include "a small plant . . . which progresses by means of underground stolons; 3 ft.; clay banks of creeks: (*Althofer 5*); "found on the fringe of forest-lands in sandy soil, on the tops of ridges in rich alluvial deposits" (*Boorman*, -.xii.1904); "on limestone hills 2000'" (*Constable NSW31196*); "amongst limestone rocks on cliff face" (*Constable NSW35324*); and "on rocky outcrops at top of bluff (*Rodd 499*). Flowering occurs from November until January (-March) and fruiting from December until May.

Specimens examined:

NEW SOUTH WALES: Althofer 5, 13.iii.1949, Dripstone, BRI (fl., fr.); *Anon s.n.*, 1.iii.1843, west of Mr Otley's station, MEL (st.); *Anon. s.n.*, Gundagai, MEL39295, NSW99081 (fl., fr.); *Anon. s.n.*, New England, MEL39440 (fr.); *Anon. 33*, rocky banks of Riv. Severn, MEL (fr.); *Anon. 315*, R. Severn-Clifton, MEL (fl., fr.); *Betche s.n.*, -.i.1883, Liverpool plains, NSW99258 (fl., fr.); *Blakely s.n.*, -.i.1900, Jenolan Caves, MEL39289, NSW99256, ('19'), SYD (fl., fr.); *Boorman s.n.*, -.xii.1904, Gungal, AD96905140, BRI080095, MEL39297, NSW99082, SYD (fl., fr.); *Boorman s.n.*, -.xi.1906, Molong, AD96920061 (fl.); *Burgess s.n.*, 7.viii.1963, Wingen, CBG016747 (st.); *Carter s.n.*, 1886, Moonan Brook, Scone, MEL1003670 (fl., fr.); Constable s.n., 22.iii.1955, Abercrombie Caves, NSW31196 (fr.); *Constable s.n.*, 23.i.1956, Bungonia Lookout, nr. Caves, NSW35324, U091001B (fr.); *Coveny 990*, 13.ii.1969, Mt. Coriaday, ca 43 km E.N.E. of Rylstone, NSW (fr.); *Cunningham s.n.*, N. Australia, MEL1003434 (fr.); *Gauba s.n.*, 7.v.1950, Burrinjuck, AD96911100, CBG015106 (fr.); *Goddard s.n.*, -.i.-, Jenolan Caves, SYD (fl.); *Huegel s.n.*, Australasia orient., W (st.); *Leichhardt s.n.*, Roolah Station, Liverpool Range,

Holotype of *Haloragis eichleri*.

MEL39286, 39287 (fl., fr.); *Maiden & Boorman s.n.*, -.vi.1906, Tamworth, AD96920060 (st.); *Moore s.n.*, the Castlereagh, MEL39294 (fl., fr.); *Moore s.n.*, Castlereagh River, MEL1003532 (fl.); *Pickard & Coveny 1144*, 5.vi.1969, between Coomoo Coomoo Creek and Henry's Creek ca 61 km W.S.W. of Quirindi, NSW (fr.); *Stuart s.n.*, River Severn, New England, MEL39291 (fr.); *Stuart 315*, New England, MEL (fl., fr.); *Rodd 499*, 23.vii.1967, Abercrombie Caves, NSW99253 (st.); *Rupp s.n.*, -.ii.1907, Warialda, NSW99257 (fl., fr.); *Rupp s.n.*, -.iii.1913, Barraba, MEL39282 (fr.); *Rupp s.n.*, -.iv.1916, Barraba, NSW99254 (fr.); *Vickery s.n.*, -.v.1959, Gulgamree near Mudgee, NSW99255 (fr.).

This species may extend to Queensland. A single specimen bearing only a few young fruits and probably representing this species is recorded as coming from "Queensland", without any definite locality (*Thozet s.n.*, 1870, Queensland, P (fr.)). The Cunningham collection cited above from "N. Australia" may also be from Queensland.

A minor morphological variation occurs in the collection *Althofer 5*, which is completely glabrous.

This species is quite closely related to *H. exalata*, differing mainly in its narrower leaves and 2- (not 4-) locular ovary.

9. **Haloragis eichleri** Orchard (Figs. Holotype, 63-71)

Haloragis eichleri Orchard, sp. nov.

Herba perennis vel suffrutex 25-50 cm altus, caules arcuati ascendentes laeves in partibus inferioribus radicantibus, pilis mollibus pellucidis simplicibus patentibus 3-5-cellularis 0.1-0.2 (-0.4) mm longis. Folia opposita, alterna prope inflorescentiam, crassa coriacea sessilia vel subsessilia in petiolis usque ad 3 mm longos, ovata vel anguste ovata, (1.5-) 3.5-5.5 cm longa (0.5-) 1.0-1.5 (-2.0) cm lata, serrata dentibus 10-15 obtusis prominentibus 2-3 mm longis, lamina supra atroviridem infra viridem pallidam. Flores 4-meri, sepala et petala et styli 4, stamina 8, loculi 4 uniovulati, ovulis pendulis. Fructus ovoidei, 2.0-2.5 mm longi 1.5-2.0 mm lati (sepala exclusa), 4-angulati obtusi inter sepala 4-sulcati, sepala opposita, subtiliter ± transverse rugosi; 3-4 loculi (1 loculus saepe abortivus), pericarpium et septa sublignosa, semina 1-4. Typus: *Hj. Eichler 20806*, 31.xii.1970, South Australia. South East. Coastal sand dunes south of Evans Cave ca 3 km south of Robe, AD97105074 (fl., fr.); Holotypus: AD97105074. Isotypi: B, FI, K, MEL, TI, UC.

Perennial herb or subshrub 25-50 cm tall, growing as independent, isolated rounded bushes, stems arcuate ascending, red to green, smooth, rooting (mainly in internodes) in lower part, branching mainly from base, prostrate parts of stems woody, erect parts herbaceous, pilose with soft, simple, pellucid, 3-5-celled, spreading hairs 0.1-0.2 (-0.4) mm long (Fig. 64).

Leaves opposite in lower parts, becoming alternate near inflorescence, dark green above, light green below, thick, leathery, sessile, or subsessile on petiole up to 3 mm long, ovate to narrow ovate, (1.5-) 3.5-5.5 cm long, (0.5-) 1.0-1.5 (-2.0) cm wide, tapering equally to either end, serrate with 10-15 blunt, prominent teeth 2-3 mm long, midrib channelled above, prominent below, lateral veins indistinct, sparsely pilose on both surfaces with hairs as for stems (Figs. 65, 66).

Inflorescence an indeterminate spike of 1-7 flowered dichasia in the axils of alternate primary bracts. Lateral inflorescences are borne in the axils of the upper 4-6 leaves. Primary bracts leaflike, lanceolate, (0.6-) 1.0-1.5 cm long, 0.2-0.4 cm wide, thick, green, entire or 2-6 serrulate, prominent midrib, pilose on margins; secondary bracts brown, membranous, linear, 1.0-2.0 mm long, 0.3-0.4 mm wide, midrib present, pilose on margins or glabrous; tertiary bracts brown, membranous, linear, 0.8-1.0 mm long, 0.2-0.3 mm wide, lacking midrib, pilose on margins or glabrous; quaternary bracts as for tertiary, 0.6-0.7 mm long, 0.2 mm wide (Figs. 67, 68).

Flowers 4-merous, those of final dichasial branches often rudimentary. Sepals 4, green, deltoid, 0.8-0.9 mm long, 0.6-0.7 mm wide, not ribbed, pilose. Petals 4, red to green, hooded, tip horizontal, shortly unguiculate, keeled, 1.8-2.3 mm long, 0.7-0.8 mm wide (keel to margin), pilose on keel. Stamens 8, filaments 0.1-0.2 mm long; anthers yellow to red, oblong, 1.5-1.8 mm long, 0.3-0.4 mm wide, 4-celled, non-apiculate, antisepalous anthers ca 0.3 mm longer than antipetalous ones. Styles 4, yellow, clavate, 0.4-0.5 mm long, stigmas capitate, red or yellow. Ovary ovoid to globose, 0.6-0.7 mm long, 0.6-0.8 mm wide, 4-angled opposite petals, pilose, 4-locular with 1 pendulous ovule per locule (Fig 69).

Fruit ovoid, 2.0-2.5 mm long, 1.5-2.0 mm wide, finely ± transversely rugose, bluntly 4-angled opposite petals, 4-furrowed opposite sepals, sessile or on pedicel 0.5 mm long, pilose with hairs as for stems; sepals persistent, erect, deltoid, 0.6-1.1 mm long, 0.7-0.8 mm wide, not ribbed, sometimes with weakly developed median basal callus; 3-4 locules (basically 4, but 1 often aborts), pericarp and septa ± woody, 1-4-seeded (Figs. 70, 71).

DISTRIBUTION: This species is confined to South Australia, being most common in the South East part of the State, from about Kingston south and eas to the Victorian border. It is also known from southern Kangaroo Island and from Port Lincoln on southern Eyre Peninsula (Fig. 63).

Figs. 63-71. *Haloragis eichleri.* 63. Distribution. 64. Habit. 65, 66. Leaves. 67. Primary bract. 68. Top of inflorescence. 69. Flower. 70. Fruit. 71. Transverse section of fruit. (Figs. 64-71 all from *Eichler 20806*). Scales represent 1 cm (figs. 64-67) or 1 mm (figs. 68-71).

ECOLOGY: *H. eichleri* has been recorded only from sand dune habitats, usually from disturbed communities. Collectors' notes include "sandhills and limestone near sea" (*Cleland AD968020568*); "recently burnt" (*Eichler 18553*); "coastal sanddunes" (*Eichler 20806*); "coastal sanddunes . . . in cleared firebreak through tall mallee" *(Orchard 3226, 3227*). Flowering occurs from November until January and fruiting from (November-) December until March.

SPECIMENS EXAMINED:

SOUTH AUSTRALIA: Alcock 85, 25.xii.1963, roadside north of The Gap, AD (fr.); *Anon s.n.,* Port Lincoln, AD96906022 (fl., fr.); *Browne 82,* Port Lincoln, MEL (fl., fr.); *Cashmore s.n.,* -.xi.1934, Cape Gantheaume, K.I., AD96810045 (fl.); *Cleland s.n.,* 18.xi.1924, Rocky River, K.I., AD96803289 (fl.); *Cleland s.n.,* 6.iii.1929, Rocky River, K.I., AD968020568 (fr.); *Cleland s.n.,* 4.xii.1934, road to Cape du Couedic K.I., AD968020566 (fr.); *Eichler 18553,* 3.i.1966, Mt. Stockade, Hundred of Newland, K.I., AD (fl., fr.); *Eichler 20806,* 31.xii.1970, south of Evans Cave ca 3 km south of Robe, AD (fl., fr.) — type of *H. eichleri*; *Hunt 1661,* 24.xi.1963, between The Gap and Western Flat, AD (fl., fr.) — pollen sent to Palyn. Lab. Stockholm sub nom. *H. heterophylla; Ising s.n.,* 24.i.1937, Wynarka, AD966031977 (fl., fr.); *Lothian 5138,* 22.xi.1970, Gum Lagoon National Park, AD

(fl.); *Orchard 3226,* 23.i.1971, ca 3 km south-east of Robe, AD (fl., fr.); *Orchard 3227,* 23.i.1971, l.c., AD (sterile seedling); *Tate s.n.,* 11.xi.1882, Beachport, AD96810010 (fl.); *Williams 3470,* 21.xii.1969, "Log Crossing" near Cantara, ca 60 km N. Meningie, AD (fl., fr.).

H. eichleri, the only species of *Haloragis* wholly endemic to South Australia, is named in honour of Dr Hj. Eichler, Keeper of the State Herbarium of South Australia (AD) since its inception in 1955 until 1973, and author of the Supplement to Black's Flora of South Australia (1965), in recognition of his efforts to promote taxonomic botany in this State.

H. eichleri approaches closely in habit, leaf, hair and fruit characteristics, *H. odontocarpa* f. *rugosa,* from which it differs principally in having ± opposite leaves which are much thicker and more shortly petiolate. Some affinity of *H. eichleri* with *H. acutangula* f. *acutangula* is indicated by their similarity in general appearance, habitat preference and distribution. Here again the most obvious difference lies in the leaves, which in *H. acutangula* are never opposite or petiolate, or as coriaceous as those of *H. eichleri*. The fruits of *H. eichleri*, where 1 locule commonly fails to develop, are unique in the genus.

10. **Haloragis odontocarpa** F. v. M. (Figs. 72-75)

Haloragis odontocarpa F. v. Mueller, Fragm. 1 (1859) 108 [Typus: "In collibus arenosis prope Kulkyne. J. Dallachy." Holotypus: *Dallachy s.n.,* Kulkyne, MEL39198 (fl., fr.)!; Isotypus (?): *Anon. s.n.,* Kulkyne, MEL39200 (fl., fr.)!] Benth., Fl. Aust. 2 (1864) 479; F. v. M., Fragm. 10 (1876) 54; Tate, Trans. R. Soc. S. Aust. 3 (1880) 64; F. v. M., Census 1 (1882) 49; F. v. M., Key Syst. Vict. Pl., 2 (1885) 22, 1 (1887-8) 261; F. v. M., Trans. R. Soc. Vict. 24 (1888) 134; F. v. M., Sec. Census 1 (1889) 85; Tate, Trans. R. Soc. S. Aust. 12 (1889) 95; Tate, Fl. S. Aust. (1890) 101; Moore, Hdbk. Fl. N.S. Wales (1893) 185; Tate, in Spencer, Rep. Horn Exped. 3 (1896) 157; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 30, 35; Schindler, Pflrch. 23 (1905) 57; Dixon, Pl. N.S. Wales (1906) 130; Black, Trans. R. Soc. S. Aust. 39 (1915) 823, 824; Maiden & Betche, Census N.S. Wales Pl. (1916) 158; Black, Fl. S. Aust. (1926) 431, 2 ed. (1952) 664; Ewart, Fl. Vict. (1931) 883; Chippendale, Trans. R. Soc. S. Aust. 82 (1959) 333; Praglowski, Grana 10 (1970) 180; Willis, Hdbk. Pl. Vict. 2 (1972) 469.

Haloragis coronopifolia Schindler, Pflrch 23 (1905) 56, fig. 17C. [Typus: "Australien: Girilambone (Betche). — Herb. Berlin." Holotypus: n.v. — probably destroyed. Isotypi: *E.Betche s.n.,* -.x.1886, Girilambone MEL38937 (fl.)!, NSW99306 (fl., fr.)!] Maiden & Betche, Census N.S. Wales Pl. (1916) 158; Praglowski, Grana 10 (1970) 180.

Figs.: F. v. M., Key Syst. Vict. Pl. 2 (1886) fig. 55; Black, Fl. S. Aust. 2 ed. (1952) fig. 878; Schindler, Pflrch 23 (1905) fig. 17C.

Annual herb (10-) 30-45 (-100) cm tall, strongly developed taproot, stems erect or ascending, branching from base, herbaceous, rooting in lower parts, green to reddish, smooth, glabrous, or pilose with soft sub-arachnoid, simple, transparent, (4-) 6-8 celled hairs, (0.2-) 0.4-1.0 mm long, concentrated on younger parts.

Leaves alternate (± opposite at extreme base), petiolate (petiole (0.5-) 0.7-1.5 (-2.0) cm long), ovate, 4.5-6.0 (-8.0) cm long, (0.7-) 1.0-1.5 (-2.5) cm wide, tapering gradually to apex, abruptly to petiole, serrate with 10-15 (-30) prominent blunt teeth 2-4 mm long, midrib sunken above, prominent below, lateral veins indistinct, departing at ca 30° to midrib, pilose on both surfaces with hairs as for stems.

Inflorescence an indeterminate spike of 3-7 (-15) flowered dichasia in the axils of alternate primary bracts. Lateral inflorescences arise in the axils of the upper leaves. Primary bracts leaflike, green, linear, 3.0-6.5 mm long, 0.8-2.0 mm wide, entire or serrate with 4-5 teeth, midrib absent, pilose; secondary bracts brown, membranous, linear, 0.6-0.7 mm long, 0.1-0.2 mm wide, pilose on margins; tertiary bracts brown, membranous, linear, 0.5-0.7 mm long, 0.1 mm wide, pilose on margins.

Flowers 4-merous, on pedicels 0.2-0.5 mm long. Sepals 4, deltoid, 0.6-1.0 mm long, 0.5-0.7 mm wide, not ribbed. Petals 4, yellow-green, hooded, tip erect, shortly unguiculate, 2.0-2.6 mm long, 0.5-0.8 mm wide, glabrous, or pilose on keel. Stamens 8, filaments 0.2-0.3 mm long; anthers yellow, linear-oblong, 1.8-2.2 mm long, 0.3-0.4 mm wide, nonapiculate, 4-locular. Styles 4, reddish, clavate, 0.3-0.4 mm long, stigmas capitate. Ovary ovoid, 0.4-0.5 mm long, 0.4-0.5 mm wide, ± 4-angled opposite petals, densely pilose.

Fruits extremely variable, 1-3 (-5) per axil, on pedicel (0.7-) 1.0-2.0 mm long, ovoid, globose, pyriform or rectangular, rugose, 4-angled, -ribbed or -winged opposite petals, wings (if present) spongy, oblong or constricted in centre, or "tooth-like" appendages borne opposite sepals; sepals persistent, erect, deltoid, (0.8-) 1.0-1.5 mm long, (0.5-) 0.8-1.5 mm wide, weakly midribbed, glabrous or pilose on outer face; 4 locules, endocarp and septa ± woody, exocarp membranous or ± spongy, 1-4 seeds.

Distribution: *H. odontocarpa* is widespread in the semi-arid areas of eastern, central and western Australia, extending in a broad band from Charleville in southern Queensland through central New

Figs. 72-75. *Haloragis odontocarpa*. 72. Distribution (× = specimens with flowers only, ■ = f. *odontocarpa*, ● = f. *rugosa*, ○ = f. *pterocarpa*, ▲ = f. *octoforma*). 73. Fruit of *H. odontocarpa* f. *pterocarpa* (from *Moore 5741*). 74, 75. Fruits of *H. odontocarpa* f. *rugosa* (74. from *Jones 3760*; 75. from *Latz 311*). Scales represent 1 mm.

South Wales and north-western Victoria to south-eastern South Australia. The species is also well collected in the Everard-George Gill Ranges area on the South Australia-Northern Territory border, and throughout south-central Western Australia (Fig. 72).

ECOLOGY: The distribution pattern of this species matches well the 20-25 (-35) cm winter rainfall isohyet. It grows in a variety of soils in open savannah woodland, the dominant tree species usually being mulga (*Acacia aneura*). In Queensland and New South Wales, it is considered to be good stock fodder, but has the effect of turning sheep's urine red, at the same time preventing fly "strike". Representative collectors' notes include "common on limestone outcrop in restricted area" (*Chippendale NT2858*); "in red gravelly loam with mulga" (*George 8708*); "in railway enclosure amongst grasses (*Amphipogon* and *Aristida* spp) on brown sandy soil" (*Hubbard & Winders 6125*); "occasional in sandy red earth with *Acacia aneura* and *Eragrostis eriopoda*" (*Lazarides 6149*); "well watered red-brown clay (*E. populnea, Acacia aneura* etc.)" (*Moore 4789*); "grows profusely on the rough ringbarked mulga country. The sheep eat it readily and apparently thrive on it. It has the effect of discolouring their urine a saffron colour, with the remarkable effect that the sheep depastured on it are kept absolutely free from fly, when sheep in the adjoining paddocks where this plant does not grow are badly struck". (*Penzer BRI080074*). Flowering and fruiting seems to occur at all times of the year.

LOCAL NAMES: "Spinach" (*Barlow BRI080079*); "Mulga Spinach" (*Latham 1, White 11867*); "Mulga Cabbage" (*White 11867*); "Nettle" (*Barlow BRI080083*); "Mulga Nettle" (*Martin BRI070875*).

SPECIMENS EXAMINED:

In common with several other *Haloragis* species, *H. odontocarpa* shows considerable variation in fruit shape, independent of variation in other characters. However, as approximately 50% of collections of this species lack fruits, they are listed separately below to establish the complete distribution pattern. Fruiting specimens are listed under their respective formae.

QUEENSLAND: Everist 2921, 25.iii.1947, Boatman Station, CANB (fl.); *Gurney 450,* 30.vii.1930, "Mount Morris" near Charleville, BRI (fl.); *Martensz s.n.,* 8.viii.1967, Gilruth Plains Stn., Cunnamulla, CANB1751 (fl.); *Martin s.n.,* 8.viii.1967, "Arabella" about 20 miles[32 km] S.E. of Charleville, BRI070875 (fl.); *Roe 337,* 22.vii.1941, Top Cane Paddock, Gilruth Plain, CANB (fl.); *White 11867,* 26.iii.1941, Wallal, BRI (fl.). *NORTHERN TERRITORY: Beauglehole 22827,* -.vii.1967, S.E. side of Mt. Conner, BEAUG (fl.); *Beauglehole 23001,* 3.vii.1967, W. of Farrer Spring, George Gill Range, BEAUG (fl.); *Beauglehole 26908,* 15.vii.1968, Kathleen Spring, George Gill Range, BEAUG (fl.); *Chippendale s.n.,* 13.viii.1957, Bagot's Creek, George Gill Range, AD95918319, CANB55780, MEL39194, NSW99313, NT3605, PERTH (fl.); *Maconochie 830,* 25.ix.1969, 22 miles [35 km] N. Mulga Park, NT (fl.). *NEW SOUTH WALES: Anon. s.n.,* -.ix.1900, Paroo River dist., M (fl.); *Beadle s.n.,* near Griffith, SYD (fl.); *Beadle s.n.,* 1942, Co. Dowling, SYD (fl.); *Betche s.n.,* -.x.1886, Girilambone, MEL38937 (fl.) — isotype (?) of *H. coronopifolia*; *Blakely & Shiress s.n.,* near Griffith, NSW99308 (fl.); *Constable s.n.,* 16.x.1947, The Meadows, U72277A (fl.); *Constable s.n.,* 30.vii.1955, 10 m [16 km] N.E. Goolgowi, NSW37863 (fl.); *McHatten s.n.,* -.viii.1913, Bourke, SYD (fl.); *Moore 4027,* 20.ix.1966, "Tundulga" about 25 miles [40 km] S.E. of Louth, CANB (fl.); *Moore 4184,* 23.ix.1966, l.c. CANB (fl.); *Moore 4613,* 18.x.1966, 42 miles [67 km] west of West Wyalong, CANB (fl.); *Moore 5521,* 29.viii.1968, "Tundulga" about 25 miles [40 km] south-east of Louth, CANB (fl.); *Mulhan s.n.,* 9.x.1970, 40 miles [64 km] N. of Balranald, NSW132775 (fl.); *Phillips s.n.,* 13.ix.1966, Round Hill Mallee Fowl Reserve, CBG023418 (fl.). *WESTERN AUSTRALIA: Burbidge 273,* -.viii.1938, Glenorn Station, Malcolm, PERTH (fl.); *Donner 4539,* 3.ix.1973, 15 miles [24 km] S. of Menzies, AD (fl.); *Gardner s.n.,* 30.viii.1945, near Pindar, PERTH (fl.); *Gardner 2410,* 25.vii.1931, 30 m [48 km] S. of Wiluna, PERTH (fl.); *George 5422,* 25.vii.1963, 22 m [33 km] W. of Browne Ra., PERTH (fl.); *McMillan s.n.,* -.ix.1958, Hamersley Range, PERTH (fl.); *Speck 1171,* 7.viii.1958 2 miles [3 km] south of Yandil, AD, BRI, CANB, PERTH (fl.); *Wilson 7425,* 28.viii.1968, Von Treuer Tableland, PERTH (fl.); *Young s.n.,* 14.vii.1875, between Youldah and Ouldabinna, MEL39195 (fl.). *SOUTH AUSTRALIA: Cleland s.n.,* 1.ix.1954, Everard Park, eastern end of Everard Ranges, AD (fl.); *Forde 492,* 4.ix.1956, 40 miles [64 km] E.S.E. of Emu, CANB (fl.);*Reid s.n.,* 24.vi.1967, Officer Creek Block — S. of Ernabella, ADW (fl.) *Spooner 77,* -.ix.1968, Everard Ranges, AD (fl.). *VICTORIA: Beauglehole 1422,* -.x.1948, Hattah National Park, BEAUG (st.); *Beauglehole 16036,* 20.ix.1966, Sunny Cliffs, S. of Mildura, BEAUG (fl.); *Beauglehole 17034,* 3.x.1960, Hattah Lakes National Park, BEAUG (fl.); *Beauglehole & Finck 29506,* 11.xi.1968, Wyperfeld National Park, BEAUG (fl.).

KEY TO FORMAE OF *H. odontocarpa,* BASED ON FRUIT SHAPE

1. Fruit 4-angled or ribbed longitudinally between sepals, not winged.
   2. Fruit with tooth-like appendages 1-1.5 mm long projecting opposite sepals. — f. *odontocarpa*
   2. Fruit lacking appendages of any sort, ± smooth or irregularly rugose. — f. *rugosa*
1. Fruit 4-winged longitudinally between sepals.
   3. Wings, entire, oblong. — f. *pterocarpa*
   3. Wings constricted in centre. — f. *octoforma*

forma **odontocarpa**

Fruits 1-3 per axil on pedicels 0.5-0.7 mm long, ovoid or rectangular, 2.0-2.5 mm long, 1.0-1.5 mm wide (excluding teeth), 4-angled between sepals, ± smooth except for long tooth-like appendages 1.0-1.5 mm long, projecting opposite sepals at base of fruit or at base and apex (i.e. 1 or 2 per side), pilose; sepals persistent, erect, deltoid, 1.0 mm long, 0.5-1.0 mm wide, faintly midribbed, pilose; fruit 4-locular, septa and endocarp woody, exocarp ± spongy in parts.

DISTRIBUTION: This forma is known only from New South Wales (Fig. 72).

SPECIMENS EXAMINED:

NEW SOUTH WALES: Anon. s.n., Kulkyne, MEL39200 (fl., fr.) — (?) isotype of *H. odontocarpa*; *Dallachy s.n.,* Kulkyne, MEL39198 (fl., fr.) — holotype of *H. odontocarpa*; *Martensz 176,* 23.v.1969, 2½ miles [4 km] east from the Euabolong turnoff along road between Lake Cargelligo-Mt. Hope, CANB (fr.).

forma **rugosa** Orchard, f. nov.

Fructus ovoideus vel globosus vel pyriformis, 2.5-3.0 mm longus (1.4-) 1.6-2.0 (-3.0) mm latus, 4-angulatus vel costatus inter sepala vel laevis, irregulariter rugosus basin versus praesertim. Typus: Hj. Eichler 13772, 19.iv.1957, South Australia. Murray Mallee. Ca 3.5 km south of Monash, ca 22 km south-west of Renmark, (fr.)! Holotypus: AD95814059. Isotypi: B, L, NSW, PE, US.

Fruits 1-3 (-5) per axil, on pedicel 2.0 mm long, ovoid, globose or pyriform, 2.5-3.0 mm long, (1.4-) 1.6-2.0 (-3.0) mm wide, 4-angled or ribbed between sepals, or smooth, irregularly rugose particularly in lower part, pilose or glabrous; sepals persistent, erect, deltoid, 1.0-1.4 mm long, 0.8-1.2 mm wide, weakly midribbed, ± 2 lateral veins, pilose or glabrous; 4 locules, septa and endocarp ± woody, exocarp membranous, 1-4 seeds (Figs. 74, 75).

DISTRIBUTION: This is one of the most widespread forms, and is found throughout the distributional area of the species, with the exception of Victoria. However, as it has been collected just across the River Murray in New South Wales (*Vickery NSW2025*) it must almost certainly occur in north-western Victoria as well. A collection reputedly from New Zealand (*Travers s.n.,* -.iii.1909, Wellington, P (fl., fr.)) is certainly wrongly labelled (Fig. 72).

SPECIMENS EXAMINED:

QUEENSLAND: Allan 196, 2.x.1941, Gilruth Plains, Cunnamulla, CANB (fl., fr.); *Barlow s.n.,* -.vi.1919, Charleville, BRI (fr.); *Ebersohn E240,* 24.viii.1962, 40 miles [64 km] N.W. of Charleville, BRI (fl., fr.); *Everist 2881,* 22.iii.1947, Coniston, S.W. of Boatman Station, BRI, CANB (fl., fr.); *Everist 5912,* 11.xi.1957, Gowrie Station about 12 miles [19 km] N.E. of Charleville, BRI (fl., fr.); *Everist 9841,* 5.iv.1972, 5 km S.E. of Charleville, BRI (fl.); *Everist & White 29,* 25.v.1936, between Bollon and Shamrock Wells, BRI (fl., fr.); *Holland 204,* 2.v 1953, Bollon-Cunnamulla road west of Nebine, CANB (fl., fr.); *Hubbard & Winders 6125,* 2.i.1931, Charleville, BRI (fr.); *Jones 3760,* 16.iii.1968, Morven, CANB (fl., fr.); *Latham 1,* 29.iv.1936, Cunnamulla, BRI (fr.); *Penzer s.n.,* 6.xi.1933, Rosewood Station near Charleville, BRI080074 (fl., fr.); *Phillips s.n.,* 22.ix.1963, 37 miles [59 km] from Charleville on road to Quilpie, CBG015868 (fl., fr.); *Simpson 3,* 20.iv.1959, 45 miles [72 km] S.W. of Cunnamulla, BRI (fl., fr.); *White 11865,* 3.iv.1941, Shamrock Wells, NSW (fl., fr.). *NORTHERN TERRITORY: Beauglehole 23520,* 9.vii.1967, Bagot Creek, George Gill Range, BEAUG (fl., fr.); *Chippendale s.n.,* 11.ix.1956, 14 m. [22 km] N.E. of Angas Downs H.S., MEL39192, NSW99314, NT2858 (fl., fr.); *Latz 311,* 11.xii.1968, Kings Canyon, AD, AK, NT (fl., fr.); *Lazarides 6149,* 7.x.1956, 7 miles [11 km] W.N.W. of Ayers Rock, AD, BRI, CANB, MEL, NT (fl., fr.). *NEW SOUTH WALES: Constable s.n.,* 16.x.1947, The Meadows, NSW4568 (fl., fr.); *Moore 4789,* 15.xii.1966, "Tundulga" about 25 miles [40 km] south-east of Louth; CANB (fl., fr.); *Mueller s.n.,* 1896, Riverina, MEL39201 (fr.); *Peacock s.n.,* -.x.1900, Girilambone, NSW99098 (fl., fr.); *Rick & Common 0327,* 24.xi.1949, 70 miles [112 km] W. of Cobar, CANB (fl., fr.); *Vickery s.n.,* 19.viii.1946, between Euston and Mildura, NSW2025 (fl., fr.). *WESTERN AUSTRALIA: Clarke 166,* -.vii.1916, E. Laverton, PERTH (fr.); *George 4007,* 25.viii.1962, 33 miles [53 km] S.E. of Winduldarra Rockhole, Warburton road, AD, PERTH (fl., fr.); *Donner 4466,* 27.viii.1973, 15 miles [24 km] west of Rebecca Creek, AD (fl., fr.); *Donner 4482,* 29.viii.1973, 29 miles [46 km] E. of Warburton Mission, AD (fl., fr.); *George 5590,* 28.vii.1963, ± 22 miles [33 km] S. of Wongawol H.S., PERTH (fl., fr.); *George 8708,* 13.vii.1967, 134 miles [214 km] N.E. of Cosmo Newberry on Warburton road, AD, PERTH (fl., fr.); *Royce 1978,* 8.vi.1947, 20 miles [32 km] south of Jigalong, PERTH (fl., fr.); *Wilson 7231,* 26.ix.1968, 32 km N. of Menzies, AD (fl., fr.); *Wilson 7288,* 26.viii.1968, Lake, Carey, PERTH (fl., fr.). *SOUTH AUSTRALIA: Cleland s.n.,* -.i.1921, Berri, AD966032608 (fl., fr.); *Eichler 13722,* 19.iv.1957, ca 3.5 km south of Monash, AD (fr.) — type of *H. odontocarpa* f. *rugosa; Reid s.n.,* 30.ix.1955, between Mt. Woodroffe & Mt. Harriet, ADW19218 (fl., fr.).

forma **pterocarpa** Orchard, f. nov.

Fructus ovoideus, 3.0-4.5 mm longus, 3.0-5.0 mm latus (alae inclusae), 4-alatus inter sepala; alae haud constrictae, oblongae, 0.5-1.5 mm latae, venis lateralibus; fructus inter alas laevis vel rugosus. Typus: A. E. Orchard 1859, 16.xii.1968, South Australia. Murray Lands. Ca 3 km south-east of Waikerie (fl., fr.)! Holotypus: AD96851140. Isotypi: B, BRI.

Fruits 1-3 (-5) per axil, on pedicels 1.0 mm long, ovoid, fruit 3.0-4.5 mm long, 3.0-5.0 mm wide (including wings), 4-winged between sepals, smooth or rugose between the wings; wings unconstricted, oblong, laterally veined, 0.5-1.5 mm wide; glabrous or pilose; sepals persistent, erect, deltoid, 1.3-1.5 mm long, 1.0-1.5 mm wide, midribbed, ± 2 lateral veins, glabrous or pilose; 4 locules, septa and endocarp ± woody, exocarp spongy, particularly the wings, 1-4 seeds (Fig. 73).

DISTRIBUTION: This forma is found throughout the range of the species (Fig. 72).

SPECIMENS EXAMINED:

QUEENSLAND: Allen A72, 6.xi.1941, St. George-Bollon rd. CANB (fl., fr.); *Barlow s.n.,* -.x.1916, Bollon, BRI080083 (fl., fr.).; *Clemens s.n.,* 15.xi.1945, Charleville, BRI080081 (fr.); *Everist 5912,* 11.xi.1957, Gowrie Station about 12 miles [19 km] N.E. of Charleville, CANB (fl., fr.). *NORTHERN TERRITORY: Chippendale s.n.,* 11.ix.1956, 14 m [22 km] N.E. of Angas Downs H.S., CANB40180 (fl., fr.); *Lazarides 6149,* 7.x.1956, 7 miles [11 km] W.N.W. of Ayers Rock, PERTH (fl., fr.). *NEW SOUTH WALES: Boorman s.n.,* -.xi.1903, Byrock, NSW99309 (fl., fr.); *Briggs 2785,* 26.v.1969, 6 miles [10 km] E. of Lethero, NSW (fr.); *Maiden s.n.,* -.xii.1908, Coolabah, MEL39205 (fl., fr.); *Martensz 177,* 23.v.1969, 2.5 miles [4 km] east from Euabolong turnoff, Lake Cargellico-Mt. Hope road, CANB, NSW (fl., fr.); *McBarron 18530,* 15.xi.1969, Byrock-Bourke, NSW (fl., fr.); *Moore s.n.,* 6.x.1886, Giriligambone, MEL1003671 (fl., fr.); *Moore 5741,* 15.iv.1971, 'Tundulya', ca 40 km S.E. Louth, CANB (fl., fr.); *Straatmans s.n.,* -.x.1958, Lake Cargelligo, CANB61346 (fl., fr.); *Tucker s.n.,* 1879, Lachlan River, MEL39196 (fl., fr.). *WESTERN AUSTRALIA: Baird s.n.,* -.viii.1961, Morowa area, UWA488 (fl., fr.); *Bennett s.n.,* 7.vii.1941, Lake Violet Station, PERTH (fl., fr.); *Burbidge 6070,* 9.v.1958, 56 miles [88 km] S. of Mundiwindi, CANB, PERTH (fl., fr.); *George 4077,* 26.viii.1962, Miss Gibson Hill, PERTH (fl., fr.); *George 8709,* 13.vii.1967, 134 miles [214 km] N.E. of Cosmo Newberry, PERTH (fl., fr.); *Royce 1978a,* 8.vi.1947, 20 miles [32 km] south of Jigalong, PERTH (fl., fr.); *Young s.n.,* 10-15.x.1875, near Ularing, MEL1003558 (fr.). *SOUTH AUSTRALIA: Cleland s.n.,* -.i.1921, Berri, AD96803063 (fl., fr.); *Cleland 46,* 2.xii.1913, Alawoona, AD (fl., fr.); *Eardley s.n.,* 20.xi.1946, Waikerie, ADW6190 (fr.); *Eichler 13722 bis,* 19.iv.1957, ca 3.5 km south of Monash, AD (fr.); *Forde 1501,* 20.x.1960, 3 miles [5 km] E.S.E. of Coffin Hill, CANB (fl., fr.); *Forde 1561,* 22.x.1960, 15 miles [24 km] S.S.W. of Observatory Hill, CANB (fl., fr.); *Gross s.n.,* -.vi.1936, Morgan-Renmark, ADW3322 (fl., fr.); *Henderson s.n.,* 14.vi.1969, ca 50 km north of Barmera, AD96927239 (fl., fr.); *Orchard 1859,* 16.xii.1968, ca 3 km south-east of Waikerie, AD (fl., fr.) — type of *H. odontocarpa* f. *pterocarpa*; *Orchard 1859A,* 16.xii.1968, l.c. AD, AK (fl., fr.). *VICTORIA: Anderson s.n.,* 30.iii.1969, Barney's Track, Hattah Lakes National Park, MEL48223 (fl., fr.); *Beauglehole & Finck 29476,* 11.xi.1968, Wyperfeld National Park, BEAUG (fl., fr.); *Meebold 6243,* Mildura, M (fl., fr.).

forma **octoforma** Orchard, f. nov.

Fructus ovoideus, 2.5-4.0 mm longus, 2.0-3.0 mm latus (alae inclusae), 4-alatus inter sepala; alae in centris constrictae; fructus inter alas rugosus, costatus. Typus: *D. J. E. Whibley 1229,* 18.ix.1963, South Australia. Far North West. Everard Range. Hill north of Everard Park Homestead. Everard Park Homestead is ca 275 km west-north-west of Oodnadatta. (fr.)! Holotypus: AD96640180.

Fruits 1-3 per axil on pedicel 0.7-1.0 mm long, octoform in outline, 2.5-4.0 mm long, 2.0-3.0 mm wide, body of fruit ovoid, rugose, 4-ribbed opposite sepals, 4-winged between sepals, the wings constricted in centre, pilose or glabrous; sepals persistent, erect, deltoid, 0.8-1.5 mm long, 0.7-1.5 mm wide, mid-ribbed, ± 2 lateral veins, pilose on outer face; 4 locules, septa and endocarp ± woody, exocarp ± spongy particularly wings, 1-4 seeds.

Distribution: This forma, although much less common than f. *rugosa* and f. *pterocarpa*, occupies much the same area. It is known throughout the range of the species, with the exception of Victoria and south-eastern South Australia (Fig. 72).

Specimens examined:

QUEENSLAND: Francis s.n., 25.ii.1934, Wallal, 19 km S. of Charleville, BRI080080 (fr.); *White 11865*, 3.iv.1941, Shamrock Wells, BRI (fr.). *NORTHERN TERRITORY: Cleland s.n.*, 7.vi.1955, between Middleton Ponds and Liddles, AD966042093 (fr.); *Horn Exped. s.n.*, 1894, McDonald Ranges, NSW99311 (fl., fr.). *NEW SOUTH WALES: Constable 4568A*, 17.x.1963, Mulwarrina Creek, Mulgowen Station, NSW (fl., fr.); *Mueller s.n.*, Riverina, P (fr.); *Wells & Gill s.n.*, -.xi.1968, "Wakoo" between Bourke & Cobar, CANB188156 (fr.). *WESTERN AUSTRALIA: Lindgren 73*, 14.ix.1966, 13 miles [21 km] N.W. of Thundelarra Station, PERTH (fr.); *Royce 4422*, 23.ix.1953, Comet Vale, N. of Kalgoorlie, PERTH (fr.). *SOUTH AUSTRALIA: Batt s.n.*, 1891, Nullarbor Plains, MEL38936 (fl., fr.); *Whibley 1229*, 18.ix.1963, north of Everard Park Homestead, AD (fr.) — holotype of *H. odontocarpa* f. *octoforma*.

Although the formae recognised above have very different shaped fruits, and might at first sight seem to warrant a status above formae, the variation in fruits (as in *H. acutangula*) is independent of other characters, and of distribution. Different formae apparently grow together in a single population, as evidenced by e.g. *Martensz 176* (f. *odontocarpa*) and *Martensz 177* (f. *pterocarpa*) growing side by side (collector's note); *Eichler 13722* (f. *rugosa*) and *Eichler 13722 bis* (f. *pterocarpa*); and a number of collections, where "duplicates" in different herbaria belong to different formae (e.g. *Chippendale s.n.*, Angus Downs; *Lazarides 6149*). The collection *Lazarides 6149* in CANB, although consisting of f. *rugosa*, has fruits of f. *rugosa*, f. *pterocarpa* and f. *octoforma* in an attached packet.

The epithets *rugosa* (wrinkled), *pterocarpa* (winged fruit) and *octoforma* (figure-of-eight shape) all refer to the fruits. Although only four fruit forms are formally recognised, others worthy of description may become apparent when more fruiting material has been collected. Even as circumscribed above, f. *rugosa* shows considerable variation.

The exact status of the name *Haloragis coronopifolia* Schindler is uncertain. The holotype in B is no longer in existence, although there are two probable isotypes in MEL and NSW. The first of these is in flower only and cannot be referred to any of the above formae. The sheet in NSW (NSW99306) contains three plants, two belonging to f. *pterocarpa* and one to f. *rugosa*. From Schindler's description and figure, it is more likely that he had a specimen of f. *pterocarpa* than of f. *rugosa*, so *H. coronopifolia* is tentatively referred to the former form.

The relationships of this species lie with *H. acutangula* and *H. eichleri*. From the former, *H. odontocarpa* can be distinguished by its broader, softer, petiolate leaves and longer, softer indumentum, and from the latter by its alternate, softer leaves, and fruits with 4 functional locules.

11. **Haloragis gossei** F. v. M. (Figs. 76, 77)

Haloragis gossei F. v. Mueller, Fragm. 8 (1874) 161 [Typus: "In Australia fere centrali montem Olgae versus; Gosse". Holotypus: *Gosse s.n.*, 1873, Mount Olga, MEL1003542 (fr.)! Isotypus: *Gosse 63*, Centre of South Australia, K (fr.)!]; Tate, Trans. R. Soc. S. Aust. 3 (1880) 64; Kempe, Trans. R. Soc. S. Aust. 3 (1880) 133; F. v. M., Fragm. 11 (1881) 134; F. v. M., Census 1 (1882) 49; Winnecke, Trans. R. Soc. S. Aust. 8 (1886) 12; F. v. M., Trans. R. Soc. S. Aust. 9 (1887) 214; F. v. M., Trans. R. Soc. Vict. 24 (1888) 136; Tate, Trans R. Soc. S. Aust. 12 (1889) 95; F. v. M., Sec. Census 1 (1889) 85; Tate, Fl. S. Aust. (1890) 101, 234; F. v. M. & Tate, Trans. R. Soc. S. Aust. 13 (1890) 101, 16 (1896) 352; Tate in Spencer, Rep. Horn. Exped. 3 (1896) 157; Moore, J. Bot. 35 (1897) 167; Moore, J. Linn. Soc. (Bot.) 34 (1899) 190; Bailey, Qld. Fl. 2 (1900) 553; Diels & Pritzel, Bot. Jb., 35 (1904) 445; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 5, 6, 29, 30, 31, 35; Schindler, Pflrch. 23 (1905) 58; Britten, J. Bot. 45 (1907) 136; Bailey, Comp. Cat. Qld. Pl. (1913) 174; Ewart & Davies, Fl. N. Terr. (1917) 214; Black, Fl. S. Aust. (1926) 431; Domin, Bibl. Bot. 89 (1929) 1035; Gardner, Enum. (1931) 99; Black, Trans. R. Soc. S. Aust. 59 (1935) 260; Black, Fl. S. Aust. 2 ed. (1952) 644; Chippendale, Trans. R. Soc. S. Aust. 82 (1959) 333; Eichler, Suppl. Black's Fl. S. Aust. (1965) 245; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 468; Praglowski, Grana 10 (1970) 180.

Figs.: Black, Trans. R. Soc. S. Aust. 59 (1935) pl. 5, fig. 2; Black, Fl. S. Aust. 2 ed. (1952) fig. 878; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 468; Praglowski, Grana 10 (1970) pl. 8 (a-h).

Herbaceous annual 20-40 cm tall, stems erect, glabrous, branching mainly from base of plant, almost lacking longitudinal ridges. Leaves bright green, soft, ± slightly succulent, lowest 2-3 pairs sub-

opposite, otherwise alternate, linear-lanceolate to oblanceolate, 2.0-5.0 cm long, 0.5-1.2 cm wide, 6-8-toothed, tapering gradually at base into a short, winged petiole 0.5-1.0 cm long, midrib smooth on upper surface, ± prominent below, glabrous.

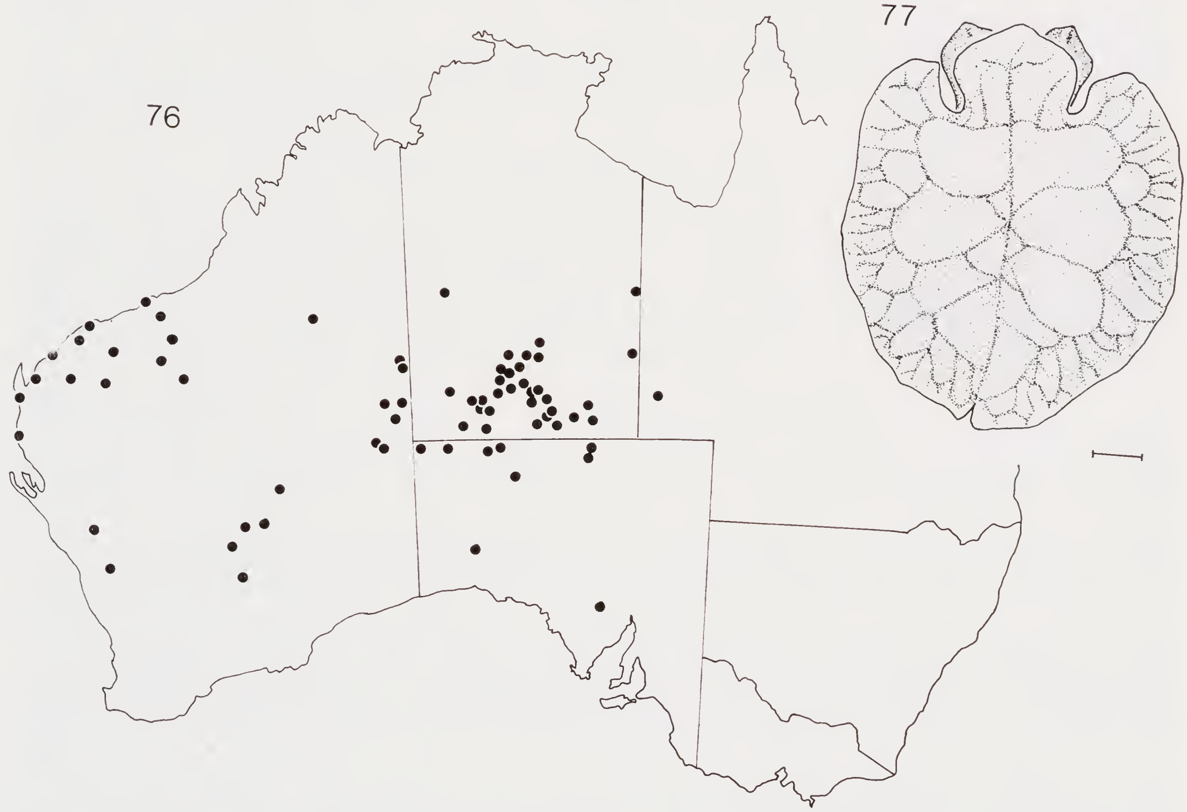
Inflorescence an indeterminate spike of 7-15-flowered dichasia borne in the axils of alternate primary bracts. Lateral inflorescences arise in the axils of the upper leaves. Only 1-7 of the flowers in each dichasium are functional, the rest are rudimentary. Primary bracts leaflike in lower parts of inflorescence, reduced and almost absent in upper parts; secondary bracts hyaline, membranous, deltoid, 0.1-0.9 mm long, caducous; tertiary and higher order bracts similar to secondary ones but minute.

Flowers trimerous, borne on pedicels 0.8-1.5 mm long, glabrous. Sepals 3, ovate, 0.8-1.0 mm long, 0.9 mm wide, not ribbed. Petals 3, usually yellow-green occasionally red or brown, hooded, 2.5-3.0 mm long, 0.7-1.0 mm wide. Stamens 6, filaments 0.2 mm long; anthers yellow to red, oblong, 2.5 mm long, 0.4 mm wide, 4-locular, non-apiculate. Styles 3, clavate, 0.5 mm long, stigmas capitate. Ovary obpyramidal, 1.0-1.5 mm long, 0.8-1.0 mm wide, 3-winged opposite petals, wings decurrent in pedicel, 3-locular with 1 ovule per locule.

Fruit green to brown, on pedicel 2 mm long, ovate or obcordate in outline, 6.5-8.0 mm long, 5.5-8.0 mm wide, body of fruit ± ovoid, 3-winged, irregularly rugose or ribbed between wings. Wings soft, membranous, slightly spongy at base, somewhat pointed at top, rounded or tapering at base, produced below body of fruit and decurrent in pedicel, veins distinct, not or only slightly prominent, anastomosing, forming 3-5 opaque large islets in each wing, finely dichotomously branched towards margins. Sepals persistent, erect, rhomboidal to obovate with 3 distinct longitudinal veins, 1.8-2.0 mm long, 2.1-2.4 mm wide, overtopped by wing apices, completely enclosing styles and stigmas. Endocarp semi-woody, exocarp membranous, 3-locular, septa moderately thick, woody, one seed per locule (Fig. 77).

Cotyledons linear to linear-lanceolate, entire, 1.5-2.0 cm long, 1.0-1.5 mm wide [*Orchard 789*].

Distribution: *H. gossei* is widespread throughout central Australia, being particularly abundant in the southern half of the Northern Territory and in central and western Western Australia. A few records exist for South Australia and Queensland, in most cases close to the Northern Territory border (Fig. 76).



Figs. 76, 77. *Haloragis gossei*. 76. Distribution. 77. Fruit (from *Symon 4387*). Scale represents 1 mm.

ECOLOGY: The distribution of this species fairly closely matches the area between the 19 and 25 cm rainfall isohyets. It grows in ± deep red sand in the wetter parts of its range, confined to clay pans and other wetter areas in the drier parts, often in association with spinifex (*Triodia* spp) and mulga (*Acacia aneura*). Collectors' notes include "on sandy loam flat below ironstone ridge" (*Burbidge 6037*), "common in deep red sand" (*Chippendale* — many collections), "in stony soil with mulga" (*George 2850*), "in red sand, with *Casuarina decaisneana*, spinifex and scattered shrubs" (*George 8901*), "common in coarse clayey sand with *Acacia aneura* and *Triodia basedowii*" (*Lazarides 5988*), "growing on lowest part of swale" (*Must 317*), "common near and in *Triodia* tussocks in deep red sand" (*Nelson 339*), "rare on calcareous soil flat with *Triodia* sp." (*Perry 3342*). Flowering and fruiting is irregular, but flowers are usually present from (May-) July to November (-March), and fruits from (July-) August to June (-July).

SPECIMENS EXAMINED:

WESTERN AUSTRALIA: Aplin 2284, 17.viii.1963, 24 miles [38 km] N.E. of Menzies on road to Leonora, PERTH (fl.) — pollen sent to Palyn. Lab. Stockholm, voucher for alkaloid survey; *Beauglehole 11542,* 16.viii.1965, 9 m [14 km] E. of Wittenoom, BEAUG (fl., fr.); *Burbidge 1052,* 9.vi.1941, near Talga River Gap, PERTH (fl., fr.); *Burbidge 5921,* 28.iv.1958, upper reaches of Turner R., Woodstock Stn., S. of Port Hedland, CANB (fr.); *Burbidge 6037,* 8.v.1958, Roy Hill-Mundiwindi, AD, CANB, PERTH (fl., fr.); *Carey s.n.,* 1878, Fortescue River, MEL1003547 (fl.); *Carey s.n.,* 1885, near Exmouth Gulph, MEL1003548 (fr.); *Carolin 6052,* 2.viii.1967, Blackstone Range, SYD (fl., fr. — terat.); *Carolin 6260,* 11.viii.1967, near the southern end of Walter James Range, SYD (fl., fr. — terat.); *Chadwick 1381,* 30.viii.1964, Cape Range near Exmouth, PERTH (fl., fr.); *Clarke 74,* -.vii.1916, east of Laverton, PERTH (fl.); *Cleland s.n.,* Port Hedland, PERTH (fr.); *Clement s.n.,* between Ashburton & De Gray Rivers, PR530030 (fl.); *Dorrien-Smith s.n.,* 1909, between Ashburton & De Gray Rivers, PR530029 (fl., fr.); *Forrest s.n.,* 1878, Nickol River, MEL1003543, 1003544, 1003545 (fl., fr.); *Forrest s.n.,* 1878, Cane River et Ashburton River, MEL1003546 (fl., fr.); *Gardner 3251,* 30.viii.1932, Barrabiddy Creek, Minilya River, PERTH (fl.); *Gardner 12164,* -.xi.1958, Perenjori, PERTH (fl.); *George 1144,* 28.viii.1960, 10 mls [16 km] S. of Onslow, PERTH (fl., fr.); *George 2850,* 24.viii.1961, 4 mls [6 km] E. of Cosmo Newberry, PERTH (fl.); *George 8221 (b),* 2.x.1966, ± 120 miles [192 km] W. of Giles Met. Station, PERTH (fr.); *George 8901,* 24.vii.1967, S. of Sir Frederick Range, AD, PERTH (fl.); *George 8979,* 27.vii.1967, Dovers Hills — 128° 40′ E, 23° 08′ S. PERTH (fl.); *George 9103,* 30.vii.1967, 15 miles [24 km] N.W. of Kidson Well (± 125° 10′ E, 22° 25′ S), AD, PERTH (fl., fr.); *George 10169,* 3.ix.1970, 10 miles [16 km] N. of Quebba H.S., PERTH (fr.); *George 10218,* 4.ix.1970, 25 miles [40 km] N. of Cardakia H.S., PERTH (fr.); *Giles s.n.,* between the Rawlinson Range & Alfred-Maries Range, MEL1003556, 1003557 (fl.); *Halford s.n.,* -.iv.1925, nr. Kalgoorlie, PERTH (fr.); *Helms s.n.,* 17.viii.1891, nr. Barrow Range, MEL1003760 (fl. — terat.); *Helms s.n.,* 28.viii.1891, nr. Mt. Squires, Barrow Range, AD96810028, MEL1003678, NSW98946 (fl.); *Ride s.n.,* -.viii.1958, Hammersley Range, PERTH (fl.); *Robinson s.n.,* 7.ix.1959, South Barlee Range, PERTH (fl.); *Speck 633,* 5.ix.1957, 13 miles [21 km] N.W. of Belele, AD, BRI, CANB (fl.); *Symon 2193,* 31.vii.1962, 78 m [125 km] S. of Giles, ADW (fl.); *Symon 2232,* 1.viii. 1962, W. end of Hopkins Lake, ADW (fl.); *Symon 2287,* 1.viii.1962, 25 m. [40 km] S. of Sir Frederick Range (± 128° 40′ E, 24° 10′ S), AD, ADW (fl., fr.); *Symon 2454,* 1.viii.1962, creekline, base of E. end of Schwerin Mural Crescent (± 128° 50′ E, 24° 50′ S), AD, ADW, PERTH (fl.); *Tietkins s.n.,* 1889, north side of Lake Macdonald, AD96810030, MEL1003715 (fl., fr. — terat.); *Wilson 7260,* 26.viii.1968, near Murrin Murrin, ca 65 km W.S.W. of Laverton, PERTH (fl.). *NORTHERN TERRITORY: Beauglehole 20237,* 8.x.1966, Mt. Ebenezer turnoff on Alice Springs road, AD, BEAUG (fl., fr.); *Beauglehole 20348,* 9.x.1966, Kings Canyon, BEAUG (fr.); *Beauglehole 23517,* 9.vii.1967, Bagot Creek, George Gill Range, AD, BEAUG (fl., fr.); *Beauglehole 23871,* 16.vii.1967, Glen of Palms, Fincke River, BEAUG (fl.); *Beauglehole 24075,* 19.vii.1967, Annabelle Gorge, BEAUG (fr.); *Beauglehole 24332,* 29.vii.1967, Corroboree Rock, E. of Alice Springs, AD, BEAUG (fl., fr.); *Beauglehole 24671,* 7.viii.1967, Small Range, 103 m. [165 km] S. of Alice Springs, AD, BEAUG (fl., fr.); *Beauglehole 26070,* 8.vii.1968, Kings Canyon, BEAUG (fl.); *Beauglehole 26312,* 9.vii.1968, Carmichael's Crag, George Gill Range, BEAUG (fl., fr.); *Carolin 5182,* 13.viii.1966, Hugh River near Stuart's Well, NSW, SYD (fl., fr.); *Chippendale s.n.,* 30.viii.1955, 36 m. [58 km] N.E. of Angas Downs H.S., AD95952007, CANB70129, NT1575, NSW98944 (fl.); *Chippendale s.n.,* 22.ix.1955, No. 2 Desert Bore, Hamilton Downs, CANB70130, NT1694 (fl.); *Chippendale s.n.,* 12.iv.1956, l.c., BRI080006, NSW98948, NT2016 (fr.); *Chippendale s.n.,* 23.viii.1956, near Ulumbaura Spring, Haasts Bluff, AD96915150, NT2570 (fl.); *Chippendale s.n.,* 14.ix.1956, 24.7 m. [39 km] S.W. Angas Downs H.S., NT2923, PERTH (fl.); *Chippendale s.n.,* 20.ix.1956, 38½ m. [62 km] S.W. Tobermorey H.S., BRI080005, NT2970 (fl.); *Chippendale s.n.,* 12.viii.1959, 12 m. [19 km] N.W. Harper Springs H.S., AD96811126, BRI119066, NT6463 (fl.); *Chippendale s.n.,* 9.ix.1959, 18 miles [29 km] S. of Lilla Creek H.S., AD96639055, NT6611 (fl.); *Chippendale s.n.,* 9.xi.1960, 10.3 miles [16.5 km] W. Xmas Bore, AD97008234, NT7442 (fr.); *Cleland s.n.,* 23.viii.1932, north of Rumbalara, AD966042132 (fl.); *Cleland s.n.,* between Middleton Ponds and Liddles, AD966042131 (fl., fr.); *Cleland s.n.,* 17.viii.1956, Haasts Bluff Reserve, AD966042134 (fl.); *Cleland s.n.,* 28.viii.1956, Gosse Range, AD966042127 (fl.); *Cleland s.n.,* 25.viii.1957, Mt. Wedge Station, AD966042077 (fl.); *Crocker s.n.,* 1939, ca 260 km east of Bundooma, AD95833116 (fr.); *Crocker s.n.,* 18.vi.1939, ca 335 km east-south-east of Alice Springs, AD96810061 (fl., fr.); *Forde 92,* 10.v.1956, A.I.B. Desert Grazing Block, NT (fl., fr.); *Gardner 11674,* 16.iii.1953, 55 miles [88 km] S.W. from Alice Springs, NT, PERTH (fl., fr.); *Giles s.n.,* near Alice Springs, MEL1003553 (fr.); *Giles s.n.,* -.v.1875, between Alice Springs & Charlotte Waters, MEL1003555 (fl.); *Gosse s.n.,* 1873, Mount Olga, MEL1003542 (fr.) — holotype of *H. gossei*; *Gosse 63,* centre of South Australia, K (fr.); *Henry s.n.,* 1889, Georgina River, MEL1003560 (fl.); *Ising 2376, 24.viii.1931,* Horse Shoe Bend, AD (fl., fr.); *Latz 252,* 9.xii.1968, 33 miles [53 km] W. Henbury, CANB (fr.); *Latz 322,* 11.xii.1968, Kings Canyon, AD, MEL (fr.); *Latz 958,* 4.xi.1970, ca 28 miles [45 km] S.S.W. Docker River settlement, AD (fl., fr.); *Latz 2279,* 5.iv.1972, Mt. Liebig area, NT (fl.); *Lazarides 5988,* 15.ix.1957, Desert Grazing Block, AD, BRI, CANB, MEL, NT, NSW, PERTH (fl., fr.); *Mahood s.n.,* 29.iii.1962, 40 miles [64 km] N.W. of The Granites, NT8740 (fl.); *Must 317,* 8.viii.1968, 17 miles [27 km] N.W. of Andado H.S., AD, CANB, MEL, NT (fl.); *Must 344,* 19.i.1968, 23 miles [37 km] S. Alice Springs, AD, AK, NT (fl.); *Nelson 339,* 21.vi.1962, 1.2

miles [2 km] E. of Connors Well, CANB, NT (fl., fr.); *Nelson 1713,* 6.viii.1968, Yuendemu road, 7 miles [11 km] S.E. Napperby Creek, AK, NT (fl.); *Nelson 1738,* 20.viii.1968, 1.5 miles [2.5 km] N. of Connors Well, AD, AK, NT (fl.); *Nelson 1768,* 15.x.1968, 62 miles [99 km] N. of Alice Springs, AD, AK, NT (fr.); *Nelson 2029,* 12.x.1970,, 25 miles [40 km] S. Alice Springs, AD, NT (fr.); *Orchard 789,* 13.vii.1968, Andado Station, ca 24 km north of homestead, AD (fl.); *Perry 3342,* 7.iii.1953, 21 miles [34 km] N.N.E. of Alice Springs township, CANB (2 sheets), NT (fl., fr.); *Pryor s.n.,* 31.viii.1966, Fincke Gorge, NSW98941 (fl.); *Schneider s.n.,* -.vii.1968, Tempe Downs, AD97033088 (fr.); *Symon 4387,* 2.xi.1966, Amerada Petroleum Corp. No. 1 Hale River (136° 43′ 35″ E, 25° 15′ 50″ S), AD, ADW, CANB (fl., fr.); *Tate s.n.,* 23.v.1894, Chambers Pillar, AD96810029 (terat.); *Thornton s.n.,* 1889, Tempe Downs, MEL1003669 (fr.); *Winkworth 1463,* 4.vi.1958, 62 miles [99 km] N.N.W. of Alice Springs, NT (terat.); *Winnecke s.n.,* 1883, Central Australia, MEL1003551, 1003552 (fl., fr.). *SOUTH AUSTRALIA: Carrick 2463,* 2 x.1969, ca 38 km north-west of Yardea, AD (fl., fr.); *Eichler 17299,* 6.ix.1963, along track to Mt. Davies ca 65 km west of Musgrave Park H.S., AD (fl.); *Forde 1096,* 2.x.1960, 37 miles [59 km] E. of Mt. Davies, CANB (fr.); *Helms s.n.,* 29.vi.1891, between camps 10 & 11, ca 72 km west-north-west of Mt. Lindsay, AD96810043, MEL1003559 (fl.); *Kempe 100,* 1879, Fincke River, MEL (fr.); *Kempe 333, 368,* 1880, Fincke River, MEL (fr.); *Lothian 1706,* 11.viii.1963, ca 100 km east of Dalhousie Springs, AD (fl.) — pollen sent to Palyn. Lab. Stockholm; *Lothian 1719,* 11.viii.1963, ca 96 km east of Dalhousie Springs, AD, NT (fl.); *Reid s.n.,* 20.ix.1955, between Musgrave and Mann Ranges, ADW19219 (fl., fr.); *Schomburgk s.n.,* Central S. Aust. AD96906034 (fl); *Weber 148,* 28.x.1966, Mt. Harriet road, ca 45 km south of Musgrave Park Station, AD (fl., fr.). *QUEENSLAND: Cornish s.n.,* 1885, Mulligan River, MEL1003561 (fr.).

A single fruiting specimen from south-western South Australia (*Lothian 4009*, 2.vi.1967, 1 km S. of Maralinga check point, AD) differs from the typical specimens in several respects, viz. stems ± distinctly 4-ribbed, leaves thicker, lanceolate, midrib channelled above, prominent below, secondary veins distinct, fruits brown, usually 4-winged, sometimes 3-winged, ± oblong, 8.5 mm long, 5.5 mm wide, stamens probably 8, styles 2, locules 2, seeds 1 (-2?). The wing venation is similar to the normal form. A decision on the taxonomic status of this form, deviating morphologically and geographically from the main population, must await the discovery of more adequate collections. A few other collections are known in which the fruits are 4-winged, but these specimens do not exhibit the other peculiarities of the Lothian plant. They can have all fruits 4-winged (*Chippendale s.n.,* NT7442) or a mixture of 3- and 4-winged fruits (*Nelson 2029*).

A number of collections from north-western Western Australia are distinguished by their swollen fruits (e.g. *George 10169, 10218*). In this they parallel the behaviour of *Glischrocaryon aureum.*

H. gossei most closely resembles *H. trigonocarpa,* and is distinguished from that species by its larger fruits with wings lacking "windows". The two species form a specialised side branch from the nuclear species of the genus, probably linking through *H. odontocarpa.*

12. **Haloragis trigonocarpa** F. v. M. (Figs. 78, 79)

Haloragis trigonocarpa F. v. Mueller, Fragm. 10 (1876) 84 [Typus: "Inter Yuin et Murchison's River; inter Alfred-Marie's Range et Rawlinson's Range; E. Giles." Lectotypus (Orchard): *Giles s.n.,* Between Yuin and the Murchison River, MEL39524 (fr.)!; Isolectotypus: *Giles s.n.,* Between Yuin and the Murchison River, MEL 39529 (fr.)!] F. v. M., Census 1 (1882) 49; F. v. M., Trans. R. Soc. Vict. 24 (1888) 137; F. v. M., Sec. Census 1 (1889) 85; Tate, Fl. S. Aust. (1890) 101, 234; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 5, 29, 30, 31, 35; Diels & Pritzel, Bot. Jb. 35 (1904) 445; Schindler, Pflrch 23 (1905) 58; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 468; Praglowski, Grana 10 (1970) 180.

Haloragis caprae Choiv. et A. Vacc, Atti Soc. Nat. Mat. Modena 65 (1934) 148-149 [Typus: "Nuova Zelanda, Isola sud, Westland, Kumara 20 aprile 1909 (G. Capra)." n.v. — see below.]

Annual herbs (5-) 10-40 cm tall, stems erect or arcuate ascending, branching mainly at base, smooth or weakly 5-ribbed, glabrous or slightly scabrous with blunt 2-3-celled simple transparent hairs 0.2 mm long.

Leaves opposite at base becoming alternate above, linear to lanceolate, (2.0-) 2.5-4.5 (-5.5) cm long, 0.3-0.9 (-1.2) cm wide, petiolate or subsessile with lamina grading into winged petiole, serrate with up to 10 teeth or sometimes almost entire, midrib channelled above, prominent below, lateral veins faint, at angle of 25°-35° to midrib, petiole up to 1.0 cm long.

Inflorescence an indeterminate spike of 3-7-flowered dichasia in axils of alternate primary bracts. Lateral inflorescences arise in axils of upper leaves. Primary bracts leaflike, green, fleshy, linear, 0.7-3.0 cm long, (0.5-) 1.5-2.0 mm wide, midribbed, serrate or entire; secondary bracts brown, membranous, linear, 0.7-1.0 mm long, 0.1-0.2 mm wide, entire, deciduous; tertiary bracts as for secondary, 0.3-0.4 mm long.

Flowers 3-merous, on pedicel 0.5-0.6 (-1.5) mm long. Sepals 3, cordate-rhomboid, 0.6-0.9 mm long, 0.9-1.2 mm wide, convex, midribbed, glabrous. Petals 3, red, hooded, tip poorly defined, unguiculate, keeled, 2.0-2.7 mm long, 0.6-1.0 mm wide (keel to margin), glabrous. Stamens 6, filaments 0.2 mm long;

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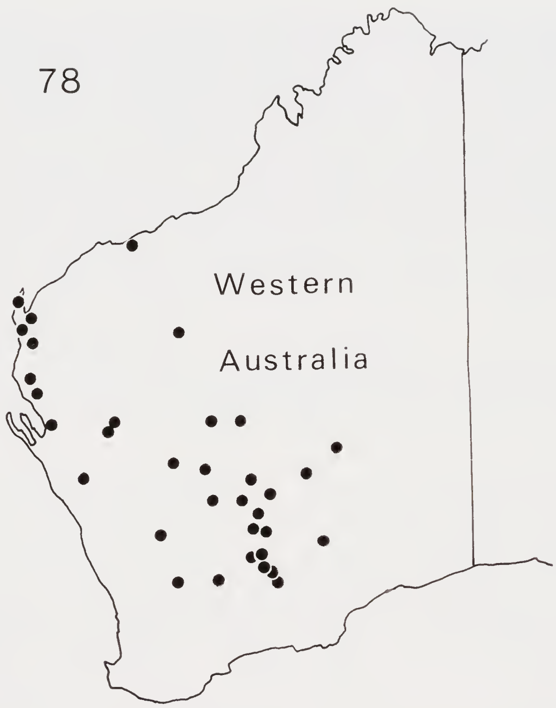


79

Figs. 78, 79. *Haloragis trigonocarpa.* 78. Distribution. 79. Fruit (from *Phillips CBG031071*). Scale represents 1 mm.

anthers yellow to red, oblong, 1.5-2.3 mm long, 0.5 mm wide, non-apiculate, 4-locular, antipetalous anthers ca 0.2 mm shorter than antisepalous. Styles 3, yellow to red, clavate, 0.5 mm long, stigmas capitate. Ovary ovoid, 0.5-0.9 mm long, 0.7-1.0 mm wide, strongly 3-ribbed or -winged opposite the petals, smooth, 3-locular with 1 pendulous ovule per locule.

Fruit trigonous, 3-winged between sepals, 4.0-4.5 (-6.0) mm long, 2.5-3.5 mm wide (including wings); wings woody, rounded at base, acute at apex, with strongly developed marginal vein and 3-5 transverse veins, area between veins membranous, translucent; body of fruit narrow ovoid, ± smooth, glabrous or rarely pilose with soft, simple, transparent, very fine unicellular hairs 0.1 mm long; sepals persistent, erect, rhomboidal to broad-deltoid, 1.0-1.4 mm long, 1.4-1.6 mm wide, ± convex, prominent median vein and ± prominent median transverse vein, glabrous or rarely pilose with hairs as above; pericarp and septa woody, 3 locules, 1-3 seeds (Fig. 79).

DISTRIBUTION: *H. trigonocarpa* is confined to Western Australia, where it occurs in the central, western and south-western regions outside the 35 cm per annum rainfall isohyet (Fig. 78).

ECOLOGY: This species grows in open situations in the semi-arid mulga-mallee regions of south-western Western Australia between the (15-) 20 and 35 cm rainfall isohyets. Collectors' notes include "red loamy alluvial flats" (*Gardner,* 9.ix.1927), "on stony hill" (*George 2780*), "in red loam with limestone" (*George 6601*), "open situations in red stony clay" (*Orchard 1230*), and "mulga scrub" (*Speck 633*). Because of the ephemeral nature of the plant, flowering and fruiting is irregular, but flowering specimens have been collected from April until September and fruiting specimens from July until April.

SPECIMENS EXAMINED:

WESTERN AUSTRALIA: Aplin 1870, 9.ix.1962, 44 miles [70 km] north of Norseman, PERTH (fr.) — voucher for alkaloid survey; *Ashby 2948,* 16.viii.1969, north of Manilya, AD, AK (fl., fr.); *Bennett 2810,* 25.ix.1968, 28 miles [45 km] S. of Coolgardie, PERTH (fl.); *Blackall s.n.,* -.ix.1939, Yandel near Lake Darlot, PERTH (fl., fr.); *Burbidge 2590,* 19.ix.1947, 10 miles [16 km] from Kalgoorlie on Coolgardie road, CANB (fl., fr.); *Burbidge 6479,* 2.ix.1959, between Woodleigh Station and Wooramel R. bridge, CANB, PERTH (fr.); *Campbell 191,* -.viii.1899, Menzies, PERTH (fr.); *Carolin 5878,* 26.vii.1967, 69 miles [110 km] east of Wiluna, SYD (fl.); *Cusack 4,* 1897, Fortescue River, Roebourne, MEL (fr.); *Dean s.n.,* -.iii.1966, Merredin, PERTH (fr.); *Diels 5205,* West Australia, NSW99274 (fr.); *Donner 3082,* 20.x.1968, ca 38 km south of Coolgardie, AD, PERTH (fl., fr.); *Donner 3084,* 21.x.1968, ca 45 km south of Coolgardie, AD, PERTH (fl., fr.); *Donner 4626,* 8.ix.1973, 32 km S. of Boulder, AD (fl.); *Eichler 20029,* 30.ix.1968, ca 10 km E.N.E. of Coolgardie, AD (fl.); *Eichler 20040,* 30.ix.1968, ca 35 km N. of Widgiemooltha, AD, PERTH (fl., fr.); *Filson 8794,* 13.ix.1966, 11 miles

[17 km] S.E. of Sandstone, MEL (fr.); *Fitzgerald s.n.*, - ix.1898, Broad Arrow, NSW98945, 98947 (fl., fr.); *Forde 1357*, 12.x.1960, 23 miles [37 km] N. of Agnew, CANB (fl., fr.); *Forrest s.n.*, 1882, Gascoyne River, MEL39527 (fl.); *Gardner s.n.*, 9.ix.1927, Bardoc, N. of Kalgoorlie, PERTH (fr.); *Gardner s.n.*, -.ix.1941, Gascoyne River, PERTH (fl., fr.); *Gardner 7543*, 29.viii.1945, north of Guttoh, PERTH (fl.) — pollen sent to Palyn. Lab. Stockholm; *Gardner 7897*, 16.x.1945, 103 m. [165 km] E. of Meekatharra, PERTH (fr.); *Gardner 9527*, 26.xi.1949, Widgiemooltha, PERTH (fr.); *George 693*, 15.iv.1960, 28 m. [45 km] N. of Paynes Find, PERTH (fl., fr.) — pollen sent to Palyn. Lab. Stockholm; *George 2780*, 22.viii.1961, 29 mls. [46 km] E. of Malcolm, PERTH (fl., fr.); *George 4154*, 30.viii.1962, 34 miles [52 km] N. of Kalgoorlie, PERTH (fl., fr.); *George 4615*, 2.vii.1963, 9 miles [14 km] E. of Rutters Soak, PERTH (fr.); *George 5886*, 22.ix.1963, Cundeelee Mission N. of Zanthus, AD, PERTH (fl., fr.); *George 6601*, 25.v.1965, 5-6 miles [8-10 km] S of Exmouth, PERTH (fl.); *George 8003*, 13.ix.1966, 11 miles [18 km] E. of Sandstone, PERTH (fl., fr.); *George 8698*, 13.vii.1967, 17 miles [27 km] N.E. of Beegull rockhole, Warburton road, PERTH (fr.); *George 9598*, 27.viii.1969, ± 3 miles [5 km] N.E. of Tamala H.S., PERTH (fr.); *George 10236*, 4.ix.1970, betw. Point Cloates & Exmouth Gulf, PERTH (fr.); *George 10273*, 5.ix.1970, Cape Range W. of Learmouth, PERTH (fr.); *Giles s.n.*, between Yuin and the Murchison River, MEL39524, 39529 (fr.) — lecto- and isolecto-type of *H. trigonocarpa*; *Helms s.n.*, W.A., NSW99276 (fl., fr.); *Helms s.n.*, -.vii.1899, Coolgardie,, PERTH (fl., fr.); *Kelso s.n.*, -.x.1900, Broad Arrow, PERTH (fr.); *King s.n.*, 1886, Lake Austin, MEL39525-6 (fr.); *Kuchel 2140*, 23.ix.1964, ca. 25 km west of Coolgardie, AD (fl., fr.); *Maiden s.n.*, -.ix.1909, Laverton, AD96920051 (fr.); *Merrall s.n.*, 1892, Parkers Range, MEL1003722 (fl., fr.); *Orchard 1230*, 29.ix.1968, ca 1½ km north of Widgiemooltha, AD (fl., fr.); *Orchard 1263*, 30.ix.1968, ca 31 km north of Widgiemooltha, AD (fl.); *Phillips s.n.*, 11.ix.1962, 73 miles [117 km] N. of Norseman, AD97133093, CBG038631 (fl., fr.); *Phillips s.n.*, 16.ix.1962, 8 miles [13 km] W. of Coolgardie, CBG031071 (fl., fr.); *Robinson 208*, 27.x.1966, Lake Moore, PERTH (fr.); *Royce 1983*, 8.vi.1947, Savoury Creek, south of Jigalong, PERTH (fr.); *Royce 4396*, 23.ix.1953, Comet Vale, PERTH (fr.); *Royce 5227*, 24.i.1956, 22 m. [35 km] East of Boulder, PERTH (fr.); *Speck 633*, 5.ix.1957, 13 m. [21 km] N.W. of Belele, PERTH (fl., fr.); *Tyson s.n.*, 1892, Upper Murchison R., MEL1003657 (fr.); *Tyson 17*, 1898, Mt. Narryer, Murchison River, PERTH (fl., fr.); *Webster s.n.*, 1900, Coolgardie, NSW99275 (fr.); *Weston s.n.*, 1892, Murchison River, MEL1003692 (fl.); *Wilson 8904*, 27.viii.1970, 24 km S.W. of Sandstone, AD, PERTH (fl., fr.); *Wilson 9924*, 2.ix.1970, Mt. Narryer Range, PERTH (fr.).

The choice of a lectotype was necessary as Mueller cited two distinct collections with his description. No specimens of the second of these collections (between Alfred-Marie and Rawlinson Range) could be located, but two sheets of the first-mentioned collection (between Yuin and Murchison's River) exist in MEL. These two MEL collections differ in that one has glabrous fruits while the other has short, dense hairs between the wings and on the outside of the sepals. The first of these sheets is chosen as lectotype because its glabrous fruits represent the usual condition in the species, and because Mueller failed to mention hairs on the fruit; he described the plant as glabrous.

Several specimens on the edge of the area of distribution show anomalous features. The most northerly collection (*Cusack 4*) has fruits with swollen pericarps, while the most south-westerly collection (*Dean s.n.*), has 4-merous fruits. The fruits of two of the most easterly collections (*Gardner 7897, George 8698*) have rounded wings with only weakly developed marginal veins, the fruit is larger than normal (6 mm long x 5 mm wide) and the sepals have weak lateral veins. These last two collections thus have some of the characters of *H. gossei*, suggesting introgression between the two species.

Although *H. caprae* was described from material allegedly collected in New Zealand, it matches *H. trigonocarpa* exactly, both in its description and in the figures given with the description. I have not seen the type. As the collector of the type specimen also visited Australia, it seems possible that a confusion of labels could have occurred. Until further collections are made in New Zealand, and differential characters between the two "species" are found, *H. caprae* should be considered as synonymous with *H. trigonocarpa*.

13. **Haloragis acutangula** F. v. M. (Figs. 80-100)

Haloragis acutangula F. v. Mueller, Trans. Vict. Inst. 1 (1855) 125 [Typus: "On ridges about Port Lincoln. C. Wilhelmi". Holotypus: *Carl Wilhelmi s.n.*, February 1855, Hills near Port Lincoln, MEL38924 (fr.)! Isotypi: *Wilhelmi s.n.*, Hills about Port Lincoln, K (Oldfield Hb) (fr.)!; *Wilhelmi s.n.*, Port Lincoln, K (Herb. F. Mueller) (fr.)!; *Carl Wilhelmi s.n.*, Port Lincoln, MEL38926 (fr. & terat.)! *Carl Wilhelmi s.n.*, exam. Dr. ferd. Mueller, MEL38925 (fr.)!]; F. v. M., Hook. J. Bot. 8 (1856) 65; Benth. Fl. Aust. 2 (1864) 478; Tate, Trans. R. Soc. S. Aust. 3 (1880) 64; F. v. M., Census 1 (1882) 49; F. v. M., Trans. R. Soc. Vict. 24 (1888) 136; F. v. M., Sec. Census 1 (1889) 85; Tate, Trans. R. Soc. S. Aust. 12 (1889) 95; Tate, Fl. S. Aust. (1890) 101, 234; Schindler, Pflrch 23 (1905) 57; Black, Trans. R. Soc. S. Aust. 49 (1925) 275; Black, Fl. S. Aust. (1926) 431, 2 ed. (1952) 644; Blackall & Grieve, W. Aust. Wildfls., 3 (1965) 470; Praglowski, Grana 10 (1970) 180.

? *Haloragis serra* [var.] *β gracilis* Sonder, Linnaea 28 (1856) 230 [Typus: "ad vias prope Bethanien, April (Dr. F. Mueller), prope Dombey — bay (Wilhelmi), et in Pine forest, Gawlertown, solo argillaceo nec non in Sand-scrub ad Tonunda, Novemb. (Dr. Behr)." n.v.]

Figs.: Black, Fl. S. Aust. (1926) fig. 175D, 2 ed. (1952) fig. 868D; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 470.

Perennial herb or subshrub, 20-30 (-45) cm tall, erect or branches arcuate ascending, often rooting at the nodes in the lower part, stems 4-ribbed, ±woody particularly near the base, green to reddish purple, glabrous or scabrous, and then hairs short, ± curved (claw-like), 1-2-celled, with the lower cell often swollen, 0.1-0.3 mm long, often confined to the ribs.

Leaves all alternate (except first 2-3 pairs of seedling leaves, which are opposite), pale green, ± dull, linear to linear-lanceolate, 1.0-3.0 (-5.0) cm long, 0.2-0.4 (-0.8) cm wide, ± flat, sessile, entire or toothed, teeth deltoid or ± linear and usually confined to the upper part of the lamina, midrib usually faint, lamina soft, ± fleshy in life, glabrous or scabrous with hairs (as for stem) on both faces or confined to margins.

Inflorescence an indeterminate spike of 1-7-flowered dichasia borne in axils of alternate primary bracts. Lateral inflorescences arise in axils of upper leaves. Primary bracts leaflike, green, fleshy, lanceolate, 5.0-8.0 (-15.0) mm long, 1.5-2.0 (-5.0) mm wide, equal to or exceeding fruit, glabrous, or scabrous only on margins. Secondary bracts membranous, yellow-brown, lanceolate, 2.0-3.0 mm long, 0.7-1.0 mm wide, entire, ± no midrib. Tertiary bracts (if present) membranous, yellow-brown, linear, 1.0-1.5 mm long, 0.3-0.4 mm wide.

Flowers 4-merous, usually all functional except those of the ultimate dichasial branches. Sepals 4, green, smooth or very faintly midribbed, deltoid, 0.8-1.0 mm long, 0.7-0.8 mm wide. Petals 4, green to red, hooded, unguiculate, glabrous or with a single row of hairs (as for stem) on keel, tip erect, 2.4-3.0 mm long, 0.7-0.8 mm wide (keel to margin). Stamens 8, filaments 0.1-0.2 mm long; anthers yellow to red, 4-locular, non-apiculate, 1.6-1.9 (-2.3) mm long, 0.4-0.5 mm wide, antipetalous ones ± equal to antisepalous ones or 0.1-0.2 mm shorter. Styles 4, yellow-green to pink or red, clavate, 0.6 mm long, stigmas ± capitate. Ovary turbinate, 0.6-1.0 mm long, 0.7-1.2 mm wide, ± 4-ribbed opposite petals, 4-locular with a single pendulous ovule in each locule.

Fruits extremely variable between plants, constant within a single plant; ± ovoid with 4-longitudinal oblong or deltoid wings alternating with the persistent sepals, or wings absent or reduced to ribs or tubercles; tubercles present on the body of the fruit between the wing positions (i.e. below the sepals) or absent; fruit shape (including the wings) ovoid or cubical or turbinate or obturbinate or fusiform or pyramidal or globose (as a result of a uniformly swollen pericarp), (1.5-) 2.0-3.0 (-3.5) mm long, (1.3-) 2.0-3.0 (-4.0) mm wide, glabrous or with scabrous hairs as for stems Sepals persistent, deltoid, 1.0-1.2 mm long, 0.8-1.0 mm wide, smooth or midrib ± apparent, median basal callus weakly developed or absent, glabrous or scabrous. Fruit 4-locular, septa complete and ± woody, with 1-4 seeds (1 per locule).

Distribution: *H. acutangula* is found in South Australia, mainly in coastal areas, from Encounter Bay to the Head of the Great Australian Bight. The only inland populations are in the Murray Mallee near Waikerie and in central Eyre Peninsula. A small population exists in Western Australia, on the mainland between Esperance and Albany, and on some islands of the Recherche Archipelago.

Ecology: See under f. *acutangula*.

Plants in this species show an unusually large degree of variation, particularly in fruit form and ornamentation, but also in leaf shape and dentation, and in the presence or absence of stiff hairs.

Typically, the plants grow in somewhat disturbed habitats in open situations (semistabilised sand dunes, roadsides, quarries, etc) in populations of several hundred individuals occupying an area perhaps one hundred metres in diameter. Within such a population most of the fruit, leaf and indumentum forms can usually be found, in various combinations. The distribution of the varying forms through the population seems to be random, although some local "clumping" may be present. Populations of this type have been observed by the author in the Murray Mallee (near Waikerie), on Yorke Peninsula (Moonta, Wallaroo, south of Cape Elizabeth, Pine Point, and Daly Head) and on Eyre Peninsula (Arno Bay, Porter Bay, Lincoln National Park, Kellidie Bay, Wangary, Mt. Hope, Elliston, Calca and Yalata). Comprehensive collections were made from these populations and from other smaller groups, in an effort to map the overall distribution of the species, as well as the distribution of the variation observed.

It was found that variation in fruit shape, leaf shape and indumentum show no correlation with each other, nor with geographical distribution. However, the extreme forms, particularly in the case of the fruits, appear at first sight to be completely unrelated, and in the past two of them have been given the rank of species (*H. ciliata* and *H. semiangulata*). For this reason, formal descriptions of some of the more common variants seems warranted, but at the level of formae, as the different taxa show no correlation of characters, are sympatric and appear to be readily inter-breeding. The twelve formae described below accommodate with few exceptions all the present collections of *H. acutangula*. They are based only on the form of the mature fruits, and each forma has the complete range of variation in leaf and indumentum characters.

Key to the formae of *Haloragis acutangula*, based on fully mature fruits

(1) Body of the fruit bearing well defined longitudinal wings (1.5-) 2-5 mm wide in the antipetalous positions.
  (2) Tubercle present between the wings.
    (3) Wings oblong, occupying the entire length of the fruit. — f. *subacutangula*
    (3) Wings ± deltoid or falco-deltoid, confined to the upper part of the fruit. — f. *semiangulata*
  (2) Tubercle not present between the wings, the body of the fruit smooth or rugose.
    (4) Wings oblong, occupying the entire length of the fruit. — f. *tetraptera*
    (4) Wings deltoid.
      (5) Wing occupying the mid-position along the length of the fruit.
        (6) Wing well developed, occupying most of the length of the fruit; the fruit (including wings) wider than long. — f. *occidentalis*
        (6) Wing weakly developed, occupying only the central part of the fruit, which is wingless above and below, fruit (including wings) longer than wide or isodiametrical. — f. *dentata*
      (5) Wing terminal or basal along the length of the fruit.
        (7) Wing in the upper part only. — f. *turbinata*
        (7) Wing at the base only. — f. *pyramidata*
(1) Body of the fruit lacking longitudinal wings in the antipetalous positions, or the wings reduced to ribs.
  (8) Exocarp uniformly swollen, fruit globose, smooth or ± 4-ribbed. — f. *inflata*
  (8) Exocarp not swollen, fruit not globose.
    (9) Tubercle present on body of fruit below sepal position.
      (10) Ribs lacking tubercle, fruit basically oblong. — f. *tetraglebosa*
      (10) Ribs with a basal or median tubercle, fruit basically fusiform or obturbinate through fusion of adjacent tubercles.
        (11) Ribs with a median tubercle, fruit fusiform. — f. *annulata*
        (11) Ribs with a basal tubercle, fruit obturbinate. — f. *obturbinata*
    (9) Tubercle absent, body of fruit smooth or slightly rugose below the sepal position.
      (12) Ribs lacking a tubercle. — f. *acutangula*
      (12) Ribs with a median tubercle. — f. *dentata*

f. **acutangula**

Fruit oblong, longer than broad, wings absent or reduced to ribs, flat faces of fruit smooth or transversely wrinkled, (1.8-) 2.0-2.5 mm long (excluding the sepals), 1.5-1.7 mm wide (Figs. 92, 93).

Distribution: This forma is one of the most common, and occurs in nearly every population. It is confined to South Australia, and almost entirely to a coastal strip about 5 km wide. Records of its occurrence exist for Eyre Peninsula from Yalata to Cowell, for Yorke Peninsula from Wallaroo to Pine Point, for Kangaroo Island and for the Encounter Bay-Murray Bridge area (Fig. 80).

Ecology: The conditions under which this forma grows are identical with those of the other formae and will not be repeated for them. Two types of habitat are occupied by this species: either deep sand of semistabilised dunes, or shallow sandy soil over limestone. The plants usually grow in open situations with few associated species other than annual or perennial grasses. Collectors' notes include "on limestone near sea" (*Copley 2444*), "common plants on sand" (*Copley 2445*), "sand dunes" (*Orchard 2068, 2071*), "shallow sandy soil over limestone" (*Orchard 2845, 2847*), "cleared verge in recent roadside cutting" (*Orchard 2851-2854*), "foot of white sand dunes on edge of track" (*Orchard 3026, 3028*) and "shallow sandy soil over limestone pavement" (*Orchard 3130, 3132, 3137, 3139*). Pollination is probably mainly anemophilous (large anthers dangling on slender filaments at anthesis, large amounts of pollen) but in two collections (*Orchard 2845, 2853*) bees were observed collecting pollen. At least two different species are involved, a black-bodied bee was the pollinator in the former case, a yellow-bodied form (*Apis mellifera*?) in the latter. Flowering takes place during December-January (-February) and fruiting from December to March or April.

Specimens examined:

SOUTH AUSTRALIA: Alcock C17B, 24.xi.1964, Cape Donnington, AD (fl., fr.); *Alcock 3322*, 21.xii.1970, South of Coffin Bay township, AD (fl., fr.); *Alcock 3327*, 21.xii.1970, Kellidie Bay National Park, AK (fr.); *Alcock 3342-6, 3348-50, 3353*, 23.xii. 1970, Sleaford Terrace, Port Lincoln, AD (fl., fr.); *Alcock 3354-6, 3363*, 29.xii.1970, south of Coffin Bay township, AD (fr.); *Alcock 3381-2*, 5.i.1971, New West Road, Port Lincoln, AD (fr.); *Alcock 3388-92*, 18.i.1971, Flinders Highway, north of Lake Greenly, AD (fr.); *Blackith & Blackith s.n.*,

Figs. 80-85. Distribution of the formae of *Haloragis acutangula*. 80. f. *acutangula*. 81. f. *annulata*. 82. f. *dentata*. 83. f. *inflata*. 84. f. *obturbinata*. 85. f. *occidentalis*.

Figs. 86-91. Distribution of the formae of *Haloragis acutangula*. 86. f. *pyramidata*. 87. f. *semiangulata*. 88. f. *subacutangula*. 89. f. *tetraglebosa*. 90. f. *tetraptera*. 91. f. *turbinata*.

-.vi.1966, Pt. Elliston, MEL38932 (fr.); *Cleland s.n.*, -.i.1922, Encounter Bay, AD968020564 (fl.); *Cleland s.n.*, 2.iii.1926, Rocky River, Kangaroo Island, AD968020578 (fr.); *Cleland s.n.*, 19.i.1940, Encounter Bay, AD968020559 (fl., fr.); *Cleland s.n.*, 18.i.1945, Encounter Bay, AD968020550, AD966032585 (fl., fr.); *Copley 2436*, 5.i.1969, Wallaroo, North Beach, AD (fl., fr.); *Copley 2444, 2445*, 19.i.1969, Proper Bay, Port Lincoln, AD (fr.); *Copley 2521, 2527*, 5.iii.1969, intersection of Maitland-Pine Point & Ardrossan-Minlaton roads, AD (fl., fr.); *Copley 2625-2627, 2634*, 27.vii.1969, ca 25 km south-east of Yalata on the dogfence, AD (fr.); *Orchard 1870, 1871*, 9.i.1969, Murray Bridge-Karoonda road ca 18 km east of Murray Bridge, AD, AK (fl., fr.) — pollen of *Orchard 1871* sent to Palyn. Lab. Stockholm sub nom. *H. ciliata*; *Orchard 2049*, 23.ii.1969, ca 2 km south-west of Moonta, AD (fr.); *Orchard 2068, 2071*, 23.ii.1969, ca 13 km south of Cape Elizabeth, AD (fl., fr.); *Orchard 2803, 2813*, 14.xii.1970, ca 4 km west of Pine Point, AD (fr.); *Orchard 2821*, 14.xii.1970, ca 5 km south-west of Edithburgh, AD (fl., fr.); *Orchard 2824*, 14.xii.1970, ca 2 km west of Wattle Point, AD (fl., fr.); *Orchard 2845, 2847*, 15.xii.1970, ca 6 km south-west of Foul Bay settlement, AD, CHR (fl., fr.); *Orchard 2851-2854*, 15.xii.1970, ca 3 km north-east of Stenhouse Bay settlement, AD (fl., fr.); *Orchard 2857*, 15.xii.1970, ca 6 km north-west of Cape Spencer, AD (fl., fr.); *Orchard 2858*, 15.xii.1970, ca 12 km north-west of Cape Spencer, AD (fl., fr.); *Orchard 2859, 2860*, 15.xii.1970, Brown's Beach, ca 13 km north of Cape Spencer, AD (fl., fr.); *Orchard 2863*, 15.xii.1970, ca 6 km north-east of Daly Head, AD (fr.); *Orchard 2867, 2868*, 15.xii.1970, Hardwicke Bay, ca 3 km north of Warooka, AD (fl., fr.); *Orchard 2878, 2881*, North Beach, Wallaroo, AD, AK (fl., fr.); *Orchard 2966, 2967*, ca 6 km north-east of Arno Bay, AD (fr.); *Orchard 3000, 3002, 3003, 3009*, 31.xii.1970, southern side of Porter Bay, Port Lincoln, AD, AK (fr.); *Orchard 3026, 3028*, 31.xii.1970, ca 6 km east of Wanna Well, Lincoln National Park, AD (fr.); *Orchard 3049, 3051, 3052, 3058, 3060*, 1.i.1971, ca 5 km east of Coffin Bay settlement, Kellidie Bay National Park AD (fr.); *Orchard 3070, 3071*, 2.i.1971, ca 3 km west of Coffin Bay settlement, AD (fl., fr.); *Orchard 3074*, 2.i.1971, ca 3 km south-east of Wangary, AD (fl., fr.); *Orchard 3085, 3086*, ca 10 km north-north-west of Warrow, AD (fr.); *Orchard 3090, 3091, 3094, 3096, 3099, 3100, 3106*, 2.i.1971, ca 7 km south-south-east of Mt. Hope, AD (fr.); *Orchard 3116, 3118, 3119, 3122*. 3.i.1971, ca 11 km north of Elliston, AD (fr.); *Orchard 3130, 3132, 3137, 3139*, 3.i.1971, ca 1 km west of Calca, AD (fr.); *Orchard 3141*, 4.i.1971, ca 30 km north of Streaky Bay, AD (fr.); *Orchard 3149, 3152, 3162, 3167, 3172, 3174, 3176, 3178*, 5.i.1971, alongside dog-proof fence at south-eastern end of Yalata Aboriginal Reserve, ca 19 km south of Waltabie Tank, AD (fl., fr.); *Richards s.n.*, -.xi.1880, Point Sinclair, 50 miles [80 km] east of Fowlers Bay, MEL38929 (fr.); *Tepper s.n.*, -.xi.1879, Ardrossan, AD96810008 (fr.); *Tepper s.n.*, 1880, Yorkes Peninsula, MEL38984, 38997 (fr.); *Wilhelmi s.n.*, -.ii.1855, Port Lincoln, MEL38924 (fr.) — holotype of *H. acutangula*; *Wilhelmi s.n.*, MEL38925 (fr.) — isotype of *H. acutangula*; *Wilhelmi s.n.*, Port Lincoln, MEL38926 (fr. + terat.) — isotype of *H. acutangula*; *Wilhelmi s.n.*, Port Lincoln, K (Herb. F. Mueller & Oldfield Hb. — two sheets) (fr.) — isotypes of *H. acutangula*.

f. **annulata** Orchard, f. nov.

Fructus plusminusve isodiametrus; alae diminutae deltatae in medio fructu; callus inter alas praesens, alis conjungentibus annulus formans; 1.7-2.2 mm longus (sepala exclusa), 2.0-2.5 mm latus. Holotypus: *A. E. Orchard 3008*, 31.xii.1970, South Australia. Southern Eyre Peninsula. Sand dunes on southern side of Porter Bay, Port Lincoln, AD97107330 (fr.)! Isotypi: CANB, H, UC, W.

Fruit fusiform, more or less isodiametric, wings poorly developed, deltoid, in a median position along the fruit; callus present between the wings, fusing with them to form an annulus; length 1.7-2.2 mm (excluding sepals), width 2.0-2.5 mm (Fig. 94).

Distribution: Only six collections of this forma are known, all from South Australia; three come from the 18th hole of the Moonta Golf Course (northern Yorke Peninsula), two from the sand dunes on the southern side of Porter Bay, Port Lincoln (southern Eyre Peninsula), and one from just north of Port Lincoln on the Lincoln Highway (Fig. 81).

Ecology: Soils as for f. *acutangula*. The flowering period is unknown, but fruits are present from December until February.

Specimens examined:

SOUTH AUSTRALIA: Alcock 3321, 15.xii.1970, Crusher road off Lincoln Highway, AD (fr.); *Orchard 2043, 2047, 2050*, 23.ii.1969, Moonta-Port Hughes road ca 2 km south-west of Moonta, on the 18th hole of Moonta Golf Course, AD, AK (fr.); *Orchard 3008*, 31.xii.1970, sand dunes on southern side of Porter Bay, Port Lincoln, AD (fr.) — holotype of *H. acutangula* f. *annulata*; *Orchard 3013*, 31.xii.1970, sand dunes on southern side of Porter Bay, Port Lincoln, AD (fr.).

f. **dentata** Orchard, f. nov.

Fructus plusminusve isodiametrus; alae in medio fructu minutae deltatae; callus inter alas absens; 3.0-3.5 mm longus (sepala exclusa), 2.5-3.0 (-4.0) mm latus. Holotypus: *A. E. Orchard 3113*, 2.i.1971, South Australia. Eyre Peninsula. Flinders Highway, ca 7 km south-south-east of Mt. Hope. (Mt. Hope is ca 40 km north-west of Cummins), AD97106142 (fr.)! Isotypi: CANB, LE, K, US.

Fruits more or less isodiametric; wings very small (sometimes reduced to tubercles), deltoid, in a median position along the fruit (which is wingless towards the extremities); 3.0-3.5 mm long (excluding the sepals), 2.5-3.0 (-4.0) mm wide.

Distribution: This forma is confined to South Australia, collections having been made from northern Yorke Peninsula (Wallaroo and Moonta) and the coastal regions of Eyre Peninsula (Yalata to Port Lincoln and Arno Bay) (Fig. 82).

Ecology: Soil preferences are as for f. *acutangula.*The flowering period is unknown, but fruiting occurs from December to February.

Specimens examined:

SOUTH AUSTRALIA: Alcock 3357-8, 3361, 29.xii.1970, south of Coffin Bay township, AD (fr.); *Orchard 2042,* 23.ii.1969, ca 2 km south-west of Moonta on 18th hole of Moonta Golf Course, AD (fr.); *Orchard 2877,* 27.xii.1970, coastal sand dunes, North Beach, Wallaroo, AD (fr.); *Orchard 2970,* 30.xii.1970, Lincoln Highway ca 6 km north-east of Arno Bay, AD (fr.); *Orchard 3010, 3011,* 31.xii.1970, sand dunes on southern side of Porter Bay, Port Lincoln, AD (fr.); *Orchard 3054, 3055,* 1.i.1971, northern end of Kellidie Bay, ca 5 km east of Coffin Bay settlement, AD (fr.); *Orchard 3087,*2.i.1971, Flinders Highway ca 10 km north-north-west of Warrow, AD (fr.); *Orchard 3108,* 2.i.1971, Flinders Highway ca 7 km south-south-east of Mt. Hope, AD (fr.); *Orchard 3113,* l.c., AD (fr.) — holotype of *H. acutagula* f. *dentata*; *Orchard 3133, 3138,* 3.i.1971, ca 1 km west of Calca, AD, AK (fr.); *Orchard 3173,* 6.i.1971, alongside dog-proof fence at south-eastern end of Yalata Aboriginal Reserve, AD (fr.).

f. **inflata** Orchard, f. nov.

Fructus globosus, laevis vel parum 4-costatus, exocarpio spongioso; 2.5-3.0 mm diameter. Holotypus: *A. E. Orchard 3114,* 2.i.1971, South Australia. Eyre Peninsula. Flinders Highway, ca 7 km south-south-east of Mt. Hope. (Mt. Hope is ca 40 km north-west of Cummins), AD97106144 (fr.)! Isotypi: B, L, MEL, UC, W.

Fruit globular, smooth or slightly 4-ribbed, the exocarp spongy and swollen, 2.5-3.0 mm diam.

Distribution: This forma is known from near Waikerie in the northern Murray Mallee, from Pine Point and Daly Head on Yorke Peninsula, and from several localities in southern Eyre Peninsula (Fig. 83).

Ecology: Soil preferences are as for f. *acutangula.* The plants are in flower in December, and fruit from December until January.

Specimens examined:

SOUTH AUSTRALIA: Copley 2523, 5.iii.1969, intersection of Maitland-Pine Point & Ardrossan-Minlaton roads, AD (fr.); *Orchard 1860,* 16.xii.1968, ca 3 km south-east of Waikerie, AD (fl., fr.); *Orchard 1866,* 16.xii.1968, ca 13 km west of Waikerie on road to Blanchetown, AD (fr.); *Orchard 2808, 2810,* 14.xii.1970, ca 4 km west of Pine Point on the Ardrossan-Port Julia road, AD, AK (fr.); *Orchard 2865,* 15.xii.1970, ca 6 km north-east of Daly Head, AD (fl., fr.); *Orchard 2972, 2974,* Lincoln Highway ca 6 km north-east of Arno Bay, AD (fr.); *Orchard 3018, 3020,* 31.xii.1970, Lincoln National Park, ca 1 km north of Pillie Lake, AD (fl., fr.); *Orchard 3089, 3095, 3109, 3111,* 2.i.1971, Flinders Highway, ca 7 km south-south-east of Mt. Hope, AD, CHR (fr.); *Orchard 3114,* l.c., AD (fr.) — holotype of *H. acutangula* f. *inflata*; *Tietkins s.n.,* Yorke Peninsula, MEL38983 (fr.).

f. **obturbinata** Orchard, f. nov.

Fructus plusminusve isodiametrus; alae diminutae deltatae basi fructu; callus inter alas praesens, alis conjungentibus annulus formans; 2.0-2.3 mm longus (sepala exclusa), 1.8-2.5 mm latus. Holotypus: *A. E. Orchard 3175,* 6.i.1971, South Australia. Far West. Alongside dog-proof fence at south-eastern end of Yalata Aboriginal Reserve ca 19 km south of Waltabie Tank. (Waltabie Tank is on the Eyre Highway, ca 70 km east of the Head of the Great Australian Bight.), AD97107026 (fr.)! Isotypi: B, L, PE, PERTH, SI, UC.

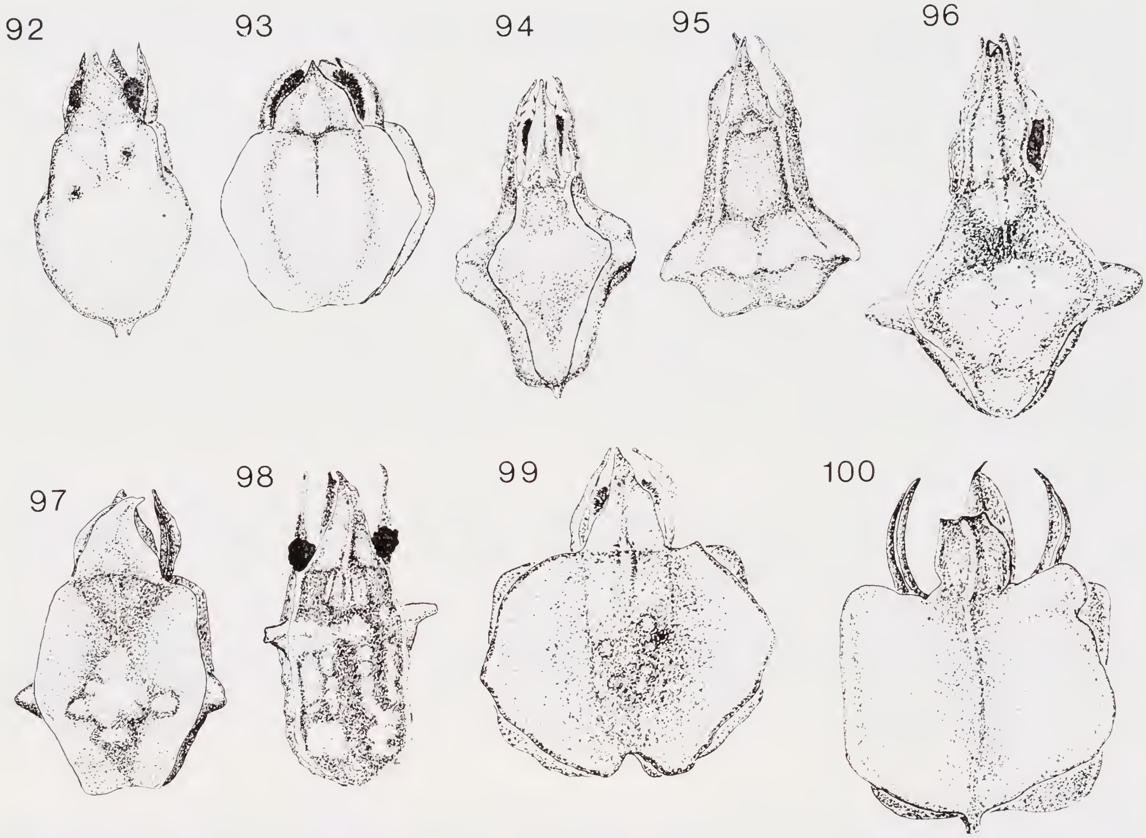
Fruit $\pm$ isodiametric, wings deltoid, poorly developed, at base of the fruit; callus present between wings and fused with them to form an annulus or "skirt"; length 2.0-2.3 mm (excluding sepals), width 1.8-2.5 mm. (Fig. 95).

Distribution: Confined to South Australia, this forma is found only in the coastal regions of southern and western Eyre Peninsula, from Yalata to Port Lincoln (Fig. 84).

Ecology: Soil preferences are as for f. *acutangula.* Flowering period is not known, but fruiting occurs in December and January.

Specimens examined:

SOUTH AUSTRALIA: Alcock 3359, 29.xii.1970, south of Coffin Bay township, AD (fr.); *Copley 2475,* 26.i.1969, Sleaford Ave, Port Lincoln, AD (fr.); *Orchard 3005,* 31.xii.1970, sand dunes on southern side of Porter Bay, Port Lincoln, AD, AK (fr.); *Orchard 3024,* 31.xii.1970, Lincoln National Park ca 6 km east of Wanna Well, AD (fr.); *Orchard 3050, 3059,* 1.i.1971, northern end of Kellidie Bay ca 5 km east of Coffin Bay settlement, AD (fr.); *Orchard 3103,* 2.i.1971, Flinders Highway ca 7 km south-south-east of Mt. Hope, AD (fr.); *Orchard 3136,* 3.i.1971, ca 1 km west of Calca, AD (fr.); *Orchard 3175,* 6.i.1971, alongside dog-proof fence at south-eastern end of Yalata Aboriginal Reserve, AD (fr.) — holotype of *H. acutangula* f. *obturbinata.*



Figs. 92-100. Fruits of *Haloragis acutangula* formae. 92, 93. f. *acutangula* (92. from *Copley 2444*; 93. from *Copley 2445*). 94. f. *annulata* (from *Orchard 2050*). 95. f. *obturbinata* (from *Copley 2475*). 96. f. *semiangulata* (from *Orchard 2044*). 97. f. *subacutangula* (from *Orchard 2045*). 98. f. *tetraglebosa* (from *Orchard 2067*). 99, 100. f. *tetraptera* (99. from *Orchard 2035*; 100. from *Orchard 2048*).

f. **occidentalis** Orchard, f. nov.

Fructus brevior quam latior; alae magnae deltatae in medio fructu vel parum infra medium, tota longitudo fructo occupans; callus inter alas absens; 1.5-2.0 mm longus (sepala exclusa), 2.0-2.5 mm latus. Holotypus: *R. D. Royce 6316,* 19.ii.1960, 1 mile N. of Esperance, W.A. Subshrub 12″-18″ (30-45 cm) tall, on roadside, PERTH (fr.)!

Fruit somewhat flattened, broader than long; wings large, deltoid, at or just below the centre of the fruit and occupying the whole length; no callus between the wings; length 1.5-2.0 mm (excluding the sepals), width 2.0-2.5 mm.

Distribution: This is the only forma known to occur outside of South Australia, and is concentrated in the Esperance-Albany district of south-western Western Australia. Specimens very similar to the Western Australian plants are also known from Yalata and Mt. Hope on western Eyre Peninsula, South Australia (Fig. 85).

Ecology: Soil preferences are as for f. *acutangula*. Flowers are present in October and fruits from November until April.

Specimens examined:

WESTERN AUSTRALIA: Bennett s.n., -.i.1941, Albany, PERTH (fr.); *Gardner s.n.,* 18.xii.1940, Esperance, PERTH (fr.); *Maxwell s.n.,* near King Georges Sound, MEL1003759 (fl.); *O.I.C. Esperance 112,* -.iv.1963, Esperance, on coastal sandhills, PERTH (fr.); *Orchard 1726, 1728,* 23.x.1968, roadside sand dunes ca 3 km north-east of Esperance, AD, AK (fl.); *Royce 6316,* 19.ii.1960, 1 mile [2 km] north of Esperance, PERTH (fr.) — holotype of *H. acutangula* f. *occidentalis*; *Willis s.n.,* 8.xi.1950, Boxer Island, Recherche Archipelago, MEL38930 (fr.); *Willis s.n.,* 23.xi.1950, Middle Island, Recherche Archipelago, MEL38931 (fr.). *SOUTH*

AUSTRALIA: Copley 2633, 27.vii.1969, ca 25 km south-east of Yalata on dog fence, AD (fr.); *Orchard 3101, 3102, 3104,* 2.i.1971, Flinders Highway, ca 7 km south-south-east of Mt. Hope, AD (fr.); *Orchard 3159,* 5.i.1971, alongside dog-proof fence at the south-eastern end of Yalata Aboriginal Reserve, AD (fr.).

f. **pyramidata** Orchard, f. nov.

Fructus plusminusve isodiametricus vel brevior quam latior; alae magnae deltatae basi fructu; callus inter alas absens; 2.0-2.5 mm longus (sepala exclusa), 2.0-2.5 mm latus. Holotypus: *A. E. Orchard 3012,* 31.xii.1970, South Australia, Southern Eyre Peninsula. Sand dunes on southern side of Porter Bay, Port Lincoln, AD97107357 (fr.)! Isotypi: B, K, MEL.

Fruit more or less isodiametric or slightly broader than long; wings deltoid, at the base of the fruit, callus between the wings absent; length 2.0-2.5 mm (excluding the sepals), width 2.0-2.5 mm.

Distribution: This forma is confined to the coastal regions of southern and western Eyre Peninsula, South Australia, from Yalata to Port Lincoln (Fig. 86).

Ecology: Soil preferences are as for f. *acutangula.*The flowering period is unknown, but fruiting occurs from December to January.

Specimens examined:

SOUTH AUSTRALIA: Orchard 3012, 31.xii.1970, sand dunes on southern side of Porter Bay, Port Lincoln, AD (fr.) — holotype of *H. acutangula* f. *pyramidata*; *Orchard 3027,* 31.xii.1970, Lincoln National Park ca 6 km east of Wanna Well, AD (fr.); *Orchard 3092, 3097, 3098, 3105,* 2.i.1971, Flinders Highway ca 7 km south-south-east of Mt. Hope, AD (fr.); *Orchard 3151,* 5.i.1971, alongside dog-proof fence at south-eastern end of Yalata Aboriginal Reserve, AD (fr).

f. **semiangulata** (Black) Orchard, comb. et stat. nov.

Haloragis semiangulata J. M. Black, Trans. R. Soc. S. Aust. 49 (1925) 275 [Typus: "Yalata (near Fowler's Bay)." Holotypus: *R. Tate s.n.,* 20.i.1879, South Australia. Western Eyre Peninsula. Yalata, ca 10 km north-west of Fowlers Bay, AD96808889 (fl., fr.)!]; Black, Fl. S. Aust. (1926) 431; 2 ed. (1952) 644.

Figs.: Black, Fl. S. Aust. (1926) fig. 175E; 2 ed. (1952) fig. 868E.

Fruit isodiametric or broader than long; deltoid wings present at top of the fruit, absent at base, callus present between wings, length 1.5-2.5 mm (excluding sepals), width 2.5-3.0 mm (Fig. 96).

Distribution: This forma has been collected in South Australia on coastal Eyre and Yorke Peninsulas from Yalata to Arno Bay and from Moonta to Pine Point (Fig. 87).

Ecology: Soil preferences are as for f. *acutangula.*The flowering period is unknown, but fruiting occurs from December until February (-May).

Specimens examined:

SOUTH AUSTRALIA: Alcock 3366, 3374, 31.xii.1970, Porter Bay, AD (fl., fr.); *Alcock 3384,* 5.i.1971, New West Road, Port Lincoln, AD (fr); *Alcock 3399,* 20.i.1971, Nundroo, AD (fr.); *Copley 36,* 13.ii.1966, Bute to Snowtown roadside, ca 8 km from Bute, AD (fr.); *Copley 2556, 2561,* 3.v.1969, Moonta, rise behind Showgrounds, AD (fr.); *Copley 2629,* 27.vii.1969, 15 miles [24 km] S E. of Yalata on dog fence, AD (fr.); *Orchard 2037, 2044, 2046,* 23.ii.1969, ca 2 km south-west of Moonta on 18th hole of Moonta Golf Course, AD (fr.); *Orchard 2807,* 14.xii.1970, ca 4 km west of Pine Point on the Ardrossan-Port Julia road, AD, CHR (fr.); *Orchard 2864, 2866,* 15.xii.1970, ca 6 km north-east of Daly Head, AD (fr.); *Orchard 2962, 2984,* 30.xii.1970, Lincoln Highway, ca 6 km north-east of Arno Bay, AD (fr.); *Orchard 3007,* 31.xii.1970, sand dunes on southern side of Porter Bay, Port Lincoln, AD (fr.); *Orchard 3053,* 1.i.1971, northern end of Kellidie Bay, ca 5 km east of Coffin Bay settlement, AD (fr.); *Orchard 3084,* 2.i.1971, Flinders Highway ca 10 km north-north-west of Warrow, AD (fr.); *Orchard 3089 bis, 3110,* 2.i.1971, Flinders Highway ca 7 km south-south-east of Mt. Hope, AD, AK (fr.); *Orchard 3150, 3160, 3163, 3177,* 5-6.i.1971, alongside dog-proof fence at south-eastern end of Yalata Aboriginal Reserve, AD (fr.); *Tate s.n.,* 20.i.1879, Yalata, ca 10 km north-west of Fowlers Bay, AD96808889 (fl., fr.) — holotype of *H. semiangulata.*

f. **subacutangula** Orchard, f. nov.

Fructus plusminusve longior quam latior; alae plusminusve magnae oblongae, tota longitudo fructu occupans; callus inter alas praesens; 2.2-2.5 (-3.0) mm longus (sepala exclusa), 2.0-2.5 mm latus. Holotypus: *B. Copley 2557,* 3.v.1969, South Australia. Yorke Peninsula. Moonta, behind Showgrounds. (Moonta is ca 130 km north-west of Adelaide on western coast), AD96928615 (fr.)!

Fruit usually ± longer than wide; wings ± well developed, oblong, occupying the entire length of the fruit; callus present between the wings; 2.2-2.5 (-3.0) mm long (excluding the sepals), 2.0-2.5 mm wide (Fig. 97).

Distribution: This forma, restricted to South Australia, is only known from northern Yorke Peninsula (Moonta and Pine Point) and from Port Lincoln (Fig. 88).

ECOLOGY: Soil preferences are as for f. *acutangula*. Flowering period is unknown, but fruiting occurs from December until May.

SPECIMENS EXAMINED:

SOUTH AUSTRALIA: Copley 2557, 3.v.1969, Moonta, behind Showgrounds, AD (fr.) — holotype of *H. acutangula* f. *subacutangula*; *Orchard 2034, 2036, 2039, 2045,* 23.ii.1969, ca 2 km south-west of Moonta on 18th hole of Moonta Golf Course, AD (fr.); *Orchard 2804, 2816,* 14.xii.1970, ca 4 km west of Pine Point on the Ardrossan-Port Julia road, AD (fr.); *Orchard 3001,* 31.xii.1970, sand dunes on southern side of Porter Bay, Port Lincoln, AD, AK (fr.).

f. **tetraglebosa** Orchard, f. nov.

Fructus longior quam brevior, plusminusve rugosus alae costis deminutae; callus medianus inter costa praesens; 2.0-3.0 mm longus (sepala exclusa), 1.3-2.0 mm latus. Holotypus: *A. E. Orchard 3131,* 3.i.1971, South Australia. Western Eyre Peninsula. Roadside, ca 1 km west of Calca. (Calca is ca 30 km south-east of Streaky Bay settlement). Shallow sandy soil over limestone pavement, AD97106122 (fr.)! Isotypi: AK, B, MEL.

Fruit longer than broad; more or less rugose, with small wings on ribs, or wings absent; callus present between the wings; 2.0-3.0 mm long (excluding sepals), 1.3-2.0 mm broad (Fig. 98).

DISTRIBUTION: This forma is confined to the coastal regions of Eyre Peninsula (Yalata to Arno Bay) and Yorke Peninsula (Moonta to Pine Point), South Australia. One collection (*McDonald s.n.*), was grown from seed collected near Lock in central Eyre Peninsula (Fig. 89).

ECOLOGY: Soil preferences are as for f. *acutangula*. The flowering period includes December, and fruiting takes place from December to May.

SPECIMENS EXAMINED:

SOUTH AUSTRALIA: Copley 2524, 2525, 5.iii.1969, intersection of Maitland-Pine Point & Ardrossan-Minlaton roads, AD (fr.); *Copley 2555, 2560,* 3.v.1969, Moonta, rise behind Showgrounds, AD (fr.); *Copley 2630,* 27.vii.1969, ca 25 km south-east of Yalata on dog fence, AD (fr.); *McDonald s.n.,* 1967, grown from seeds from Lock, AD96845299 (fr.); *Orchard 2067,* 23.ii.1969, sand dunes ca 13 km south of Cape Elizabeth, AD (fr.); *Orchard 2811, 2815,* 14.xii.1970, ca 4 km west of Pine Point on the Ardrossan-Port Julia road, AD, CHR (fr.); *Orchard 2861,* 15.xii.1970, ca 6 km north-east of Daly Head, AD (fr.); *Orchard 2976, 2983,* 30.xii.1970, Lincoln Highway ca 6 km north-east of Arno Bay, AD (fr.); *Orchard 3004,* 31.xii.1970, sand dunes on southern side of Porter Bay, Port Lincoln, AD (fr.); *Orchard 3017,* 31.xii.1970, Lincoln National Park, ca 1 km north of Pillie Lake, AD (fl., fr.); *Orchard 3131,* 3.i.1971, roadside ca 1 km west of Calca, AD, AK (fr.) — type of *H. acutangula* f. *tetraglebosa*; *Orchard 3135,* l.c., AD (fr.); *Orchard 3145, 3148, 3158, 3161, 3165, 3168, 3169, 3170,* 5-6.i.1971, alongside dog-proof fence at south-eastern end of Yalata Aboriginal Reserve, AD, AK (fr.).

f. **tetraptera** Orchard, f. nov.

Fructus plusminusve isodiametrus vel latior quam longior; alae magnae oblongae tota longitudo fructu occupans; fructus inter alas laevis vel rugosus, callus absens; 2.0-2.5 mm longus (sepala exclusa), 2.0-3.0 (-4.0) mm latus. Holotypus: *A. E. Orchard 2035,* 23.ii.1969, South Australia. Northern Yorke Peninsula. Moonta-Port Hughes road ca 2 km south-west of Moonta on 18th hole of Moonta Golf Course. (Moonta is on Spencer Gulf ca 18 km south of Wallaroo), AD97111018 (fr.)! Isotypi: B, K, LE, MEL, S, TI, UC, US.

Haloragis ciliata Black, Trans. R. Soc. S. Aust. 49 (1925) 275 [Typus: "Murray Lands". Lectotypus: (Orchard): *Agric. Bureau s.n.,* 20.xii.1917, Geranium (Pinnaroo Rly), AD (fr.)! Isolectotypus (?): *J. M. Black s.n.,* 20.xii.1917, Geranium (Pinnaroo Rly), MEL38935 (fr.)! Syntypus: *J. B. Cleland s.n.,* 13.iv.1924, near Mannum, Riv. Murray, AD (fr.)]; Black, Fl. S. Aust. (1926) 431, 2 ed. (1952) 644; Praglowski, Grana 10 (1970) 180.

FIG.: Black, Fl. S. Aust. 2 ed. (1952) fig. 877.

Fruit isodiametric or wider than broad; wings oblong, well developed, occupying whole length of fruit, space between the wings smooth or rugose, callus absent; length 2.0-2.5 mm (sepals excluded), width 2.0-3.0 (-4.0) mm (Figs. 99, 100).

DISTRIBUTION: This form is one of the most common and widespread in the species, although restricted to South Australia. It is known from Eyre Peninsula (Yalata to Cowell), Yorke Peninsula (Wallaroo to Pine Point), Fleurieu Peninsula (Brighton to Port Elliot) and Kangaroo Island. It is also the only forma known to occur in inland localities, having been collected from near Kimba (mid-northern Eyre Peninsula) and the Murray Mallee (Fig. 90).

ECOLOGY: Soil preferences are as for f. *acutangula*. Flowering takes place from (August-) November until January and fruiting from (August-) November until April (-May).

SPECIMENS EXAMINED:

SOUTH AUSTRALIA: Agric. Bureau s.n., 20.xii.1917, Geranium, AD (fr.) — lectotype of *H. ciliata*; *Adams s.n.,* 21.xi.1946, Sandalwood, ADW10095 (fl., fr.); *Alcock 3331,* 21.xii.1970, Kellidie Bay National Park, AK (fr.); *Alcock 3351-2,* 23.xii.1970, Sleaford Terrace, Port Lincoln, AD (fl., fr.); *Alcock 3360, 3364-5,* 29.xii.1970, south of Coffin Bay township, AD (fr.); *Alcock 3383,* 5.i.1971, New West Road, Port Lincoln, AD (fr.); *Black*

s.n., 20.xii.1917, Geranium, MEL38935 (fr.) — isolectotype of *H. ciliata*; *Cleland s.n.,* 13.iv.1924, near Mannum, AD (fr.) — syntype of *H. ciliata*; *Cleland s.n.,* 16.viii.1924, Karoonda, AD96803064 (fl., fr.); *Cleland s.n.,* 13.xii.1924, Brighton sandhills, AD968020565 (fl., fr.); *Cleland s.n.,* 25.i.1926, between Victor Harbour and Port Elliott, AD968020574 (fr.); *Cleland s.n.,* 6.iii.1929, Rocky River, K.I., AD968020579 (fr.); *Cleland s.n.,* 19.i.1934, Chiton Rocks, AD966032591 (fl., fr.); *Cleland s.n.,* 7.xii.1934, mouth of South-west River, K.I., AD96803094 (fl.); *Cleland s.n.,* 24.i.1936, between Victor Harbour and Port Elliot, AD968020480 (fr.); *Cleland s.n.,* 10.iv.1936, Cape Spencer, AD968020555 (fr.); *Cleland s.n.,* 27.i.1940, mouth of South-West River, K.I., AD968020567 (fr.); *Cleland s.n.,* 18.xii.1941, near Lake Wangary, AD968020560 (fl.); *Cleland s.n.,* 26.xii.1953, Port Elliot, AD968020570 (fl., fr.); *Cleland s.n.,* 16.iii.1963, Rocky River, K I., AD96410058 (fl., fr. — terat.) — pollen sent to Palyn. Lab. Stockholm; *Cleland s.n.,* 8.iv.1967, near Mouth of Marne, AD96727028 (fr.); *Cleland 30,* 2.xii.1913, Alawoona, AD, NSW (fl., fr.); *Cleland 46,* 2.xii.1947, Alawoona, NSW (fl., fr.); *Copley 2452,* 21.i.1969, 20 miles [32 km] north of Cowell, AD (fr.); *Copley 2457,* 25.i.1969, Fishery Bay, Pt. Lincoln, AD, AK (fr.); *Copley 2526,* 5.iii.1969, intersection of Maitland-Pine Point & Ardrossan-Minlaton roads, AD (fl., fr.); *Copley 2558, 2559,* 3.v.1969, Moonta behind Showgrounds, AD (fr.); *Copley 2593,* 26.vii.1969, ca 50 km west of Kimba, AD (fr.); *Copley 2950,* 29.xii.1969, 20 miles [32 km] east of Kimba, AD (fl., fr.); *Hunt 3345,* 17.xii.1970, Parsons Reserve Waitpinga, AD (fl.); *Ising s.n.,* 9.i.1937, Karoonda, AD96803148 (fr.); *Ising s.n.,* 24.i.1937, Wynarka, AD966032013 (fr.); *Orchard 1853,* 16.xii.1968, ca 16 km west of Waikerie on road to Blanchetown, AD (fr.); *Orchard 1865,* 16.xii.1968, ca 13 km west of Waikerie, AD, CHR (fr.); *Orchard 1872,* 9.i.1969, Perponda, AD (fr.); *Orchard 1873,* 9.i.1969, ca 15 km south of Waikerie on the road to Karoonda, AD (fr.); *Orchard 2035,* 23.ii.1969, ca 2 km south-west of Moonta on 18th hole of Moonta Golf Course, AD (fr.) — holotype of *H. acutangula* f. *tetraptera*; *Orchard 2038, 2040, 2048,* l.c., AD, AK (fr.); *Orchard 2069, 2072,* 23.ii.1969, sand dunes ca 13 km south of Cape Elizabeth, AD (fr.); *Orchard 2407, 2410, 2413,* 10.xii.1969, ca 1 km south of Moonta, AD (fl.); *Orchard 2802, 2805, 2806, 2809, 2812, 2814,* 14.xii.1970, ca 4 km west of Pine Point on the Ardrossan-Port Julia road, AD, AK (fr.); *Orchard 2855, 2856,* 15.xii.1970, ca 3 km north-east of Stenhouse Bay settlement, AD (fl., fr.); *Orchard 2869,* 15.xii.1970, ca 5 km south of Port Rickaby on the track to The Bluff, AD (fl., fr.); *Orchard 2880,* 27.xii.1970, coastal sand dunes, North Beach, Wallaroo, AD (fr.); *Orchard 2961, 2963, 2964, 2965, 2969, 2975, 2977, 2978, 2986,* 30.xii.1970, Lincoln Highway ca 6 km north-east of Arno Bay, AD, AK (fl., fr.); *Orchard 2999, 3006,* 31.xii.1970, sand dunes on southern side of Porter Bay, Port Lincoln, AD, AK (fr.); *Orchard 3022, 3023,* 31.xii.1970, Lincoln National Park, ca 5 km east of Wanna Well, AD (fr.); *Orchard 3048, 3057, 3061,* 1.i.1971, northern end of Kellidie Bay ca 5 km east of Coffin Bay settlement, AD (fr.); *Orchard 3082,* 2.i.1971, Flinders Highway, ca 10 km north-north-west of Warrow, AD (fr.); *Orchard 3112,* 2.i.1971, Flinders Highway, ca 7 km south-south-east of Mt. Hope, AD (fr.); *Orchard 3117,* 3.i.1971, Flinders Highway, ca 11 km north of Elliston, AD (fr.); *Orchard 3129, 3134,* 3.i.1971, ca 1 km west of Calca, AD (fr.); *Orchard 3147, 3153, 3171,* 5-6.i.1971, alongside the dog-proof fence at the south-eastern end of Yalata Aboriginal Reserve, AD (fl., fr.); *Rohrlach 162,* 15.ii.1959, ca 36 km west-north-west of Kimba, AD (fr.); *Tate s.n.,* -.xi.1889, southern Yorke Peninsula, AD96810047 (fl.).

f. **turbinata** Orchard, f. nov.

Fructus plusminusve isodiametrus vel latior quam longior; alae diminutae vel magnae deltatae in apice fructu; fructus inter alas transverse rugosus callus absens; 1.5-2.0 mm longus (sepala exclusa), 2.0-2.5 mm latus. Holotypus: *A. E. Orchard 3120,* 3.i.1971, South Australia. Eyre Peninsula. Flinders Highway, ca 11 km north of Elliston. (Elliston is ca 185 km west of Cowell on western coast of Eyre Peninsula), AD97106076 (fr.)! Isotypi: B, CANB, K, PE, UC.

Fruit more or less isodiametric or broader than long, the wings deltoid, well- or poorly-developed, at the top of the fruit; between the wings the fruit is flattened and transversely rugose, lacking a callus; length 1.5-2.0 mm (excluding the sepals), width 2.0-2.5 mm.

DISTRIBUTION: This forma is known from the coastal regions of Eyre Peninsula from Yalata to Arno Bay and of Yorke Peninsula from Wallaroo to north of Port Wakefield. One collection, probably belonging here, has been made from Meningie near Encounter Bay (Fig. 91).

ECOLOGY: Soil preferences are as for f. *acutangula*. Flowering is known to occur from December to January and fruiting from December to February.

SPECIMENS EXAMINED:

SOUTH AUSTRALIA: Alcock 3347, 23.xii.1970, Sleaford Terrace, Port Lincoln, AD (fl., fr.); *Alcock 3362,* 29.xii.1970, south of Coffin Bay township, AD (fr.); *Alcock 3385,* 5.i.1971, New West Road, AD (fr.); *Copley 922,* 1.xii.1966, ca 1½ km east-north-east of Bute on Snowtown road, AD (fl., fr.); *Copley 2432,* 1.i.1969, Wallaroo North beach, AD (fl., fr.); *Copley 2522,* 5.iii.1969, intersection of Maitland-Pine Point & Ardrossan-Minlaton roads, AD (fr.); *Orchard 2041,* 23.ii.1969, ca 2 km south-west of Moonta on 18th hole of Moonta Golf Course, AD (fr.); *Orchard 2051, 2052,* 23.ii.1969, Port Hughes, ca 2 km east of the jetty, AD (fr.); *Orchard 2412, 2414,* 10.xii.1969, ca 1 km south of Moonta, AD (fl., fr.); *Orchard 2862,* 15.xii.1970, ca 6 km north-east of Daly Head, AD (fr.); *Orchard 2879,* 27.xii.1970, coastal sand dunes, North Beach, Wallaroo, AD (fr.); *Orchard 2968, 2971, 2973, 2985,* 30.xii.1970, Lincoln Highway, ca 6 km north-east of Arno Bay, AD (fr.); *Orchard 3019,* 31.xii.1970, Lincoln National Park, ca 1 km north of Pillie Lake, AD (fl., fr.); *Orchard 3025, 3029,* 31.xii.1970, Lincoln National Park, ca 6 km east of Wanna Well, AD (fl., fr.); *Orchard 3056,* 1.i.1971, northern end of Kellidie Bay, ca 5 km east of Coffin Bay settlement, AD (fr.); *Orchard 3083,* 2.i.1971, Flinders Highway, ca 10 km north-north-west of Warrow, AD (fr.); *Orchard 3093,* 2.i.1971, Flinders Highway, ca 7 km south-south-east of Mt. Hope, AD (fr.); *Orchard 3120,* 3.i.1971, Flinders Highway, ca 11 km north of Elliston, AD (fr.) — holotype of *H. acutangula* f. *turbinata*; *Orchard 3121,* l.c., AD (fr.); *Orchard 3146, 3154, 3164,* 5-6.i.1971, alongside dog-proof fence at south-eastern end of Yalata Aboriginal Reserve, AD (fl., fr.); *Williams 2415,* 5.xii.1965, Meningie near Coorong, AD (fl., fr.).

The choice of a lectotype for *H. ciliata* was necessary as two different collections in AD were annotated by Black, without either being nominated as the (holo-) type. While either of these two collections seem to be equally qualified to serve as lectotype, the one chosen contains slightly more and better preserved material. A collection in the Melbourne Herbarium (MEL38935) is probably a duplicate of the lectotype.

The plant described by Sonder (1856) as *H. serra* var. *gracilis* is most likely *H. acutangula*. None of the collections cited by Sonder have been located, but the description, localities mentioned (Bethany, Tumby ['Dombey'] Bay and Gawler), and the fact that Sonder thought that his plant resembled *H. aspera*, all suggest that it was *H. acutangula*.

H. acutangula forms a link between *H. eichleri* and *H. aspera*. From *H. eichleri* it is distinguished by its functionally 4-locular fruits which are usually winged or ornamented, and by its alternate, thinner leaves, and from *H. aspera* it is distinguished by its unhooked hairs and lack of stolons.

14. **Haloragis aspera** Lindl. (Figs. 101-121)

Haloragis aspera Lindley in Mitchell, Journ. Trop. Aust. (1848) 306 [Typus: leg. Mitchell, 13.ix.1846, open grassy plains east of the united channel of Rivers Nive and Nivella. Holotypus: *Lieut.-Col. Sir T. L. Mitchell 624*, 1846, Victoria R. Sub. Tropical New Holland. CGE (fl., fr.)!]; A. Gray, Bot. U.S. Expl. Exped. 1 (1854) 627; F. v. M., Key Syst. Vict. Pl. 1 (1887-8) 262; F. v. M., Trans. R. Soc. Vict. 24 (1888) 136; Tate, Trans. R. Soc. S. Aust. 12 (1889) 95; F. v. M., Sec. Census 1 (1889) 85; F. v. M. & Tate, Trans. R. Soc. S. Aust. 13 (1890) 101; Tate, Trans. R. Soc. S. Aust. 13 (1890) 117; Tate, Fl. S. Aust. (1890) 101, 234; Koch, Trans. R. Soc. S. Aust. 22 (1898) 111; Moore, Hdbk. Fl. N.S. Wales (1893) 185; Dixon, Pl. N.S. Wales (1906) 129; Praglowski, Grana 10 (1970) 176.

Haloragis pinnatifida A. Gray, Bot. U.S. Expl. Exped. 1 (1854) 627 [Typus: "Hab. New South Wales; on Hunter's River." Holotypus: *Wilkes s.n.*, Hunter's River, New South Wales, US47835 (fl., fr.)!]; Hook. f., Fl. Tasm. 1 (1856) 119; F. v. M., Census 1 (1882) 50; Schindler, Pflrch 23 (1905) 46.

H. heterophylla var. *capreolicornis* Schindler, Pflrch 23 (1905) 46 [Typus: "Australien: Victoria, Neu-Süd-Wales, (Sidney-Herb. n. 6, 10, 11a), Queensland (Lhotsky, F. v. Mueller). Tasmanien (Lhotsky, Stuart) — Herb. Barb.-Boiss., Berlin, Breslau, Deless., Petersb., Wien." Lectotypus (Orchard): *C. Stuart s.n.*, Van Diemansland, LE (fl., fr.)! Isolectotypi: *C. Stuart s.n.*, Van Diemensland, HBG, MEL1003762 p.p., W (fl.)!; Syntypus: *Dr. Lhotzky*, Terra de Van Dieman, G (Hb. Deless.) (fr.)!]; Britten, J. Bot. 45 (1907) 136; Maiden & Betche, Census N.S. Wales Pl. (1916) 158.

H. heterophylla var. *glaucifolia* Schindler, Pflrch 23 (1905) 46 [Typus: "Australien: Victoria (Wawra It. Cob. n. 506), Süd-Australien (Koch n. 295). Neu-Süd-Wales (Sidney-Herb. n. 8, 15). — Herb. Berlin, Göttingen, Petersb., Wien." n.v. Isosyntypi: *Betche s.n.*, -.ix.1900, Paroo River District, N.S.W., NSW113156 ("15") (fl.)!; *Koch 295*, -.iii.1898, Mt. Lyndhurst, South Australia, BRI080034 (fr.)!; *Koch 295*, -.iv.1898, Mt. Lyndhurst, S.A., NSW99203 (fr.)!; *Koch 295*, -.viii.1899, Mt. Lyndhurst, K (fr.); *Koch 295*, -.ix.1899, Mt. Lyndhurst, M (fl., fr.)!; *Koch 295*, -.v.1898, -.x.1899, Mt. Lyndhurst, AD96906021 (fl., fr.); *Koch 295*, -.x.1899, Mt. Lyndhurst, AD96803792 (fr.)!; *Walter s.n.*, -.x.1900, Wimmera Distr., NSW9836 ("8") (fr.)!]; Maiden & Betche, Census N.S. Wales Pl. (1916) 158; Black, Trans. R. Soc. S. Aust. 41 (1917) 49, 43 (1919) 40; Eichler, Suppl. Black's Fl. S. Aust. (1965) 245.

Haloragis heterophylla var. *aspera* (Lindl.) Schindler, Pflrch 23 (1905) 46; Maiden & Betche, Census N.S. Wales Pl. (1916) 158; Black, Trans. R. Soc. S. Aust. 41 (1917) 644; Ewart, Fl. Vict. (1931) 883.

Haloragis heterophylla var. *rigida* Schindler, Pflrch 23 (1905) 46 [Typus: "Australien: Victoria (F. v. Mueller) — Herb. Berlin, Halle, Petersb., Wien." Lectotypus (Orchard): *Ferd. von Mueller s.n.*, Ovens River, Victoria, LE (fl.)! Isolectotypus: *Ferd. von Mueller s.n.*, Victoria. Ovens River, NSW113157 ex W (st.)! Syntypus: *Ferd. Mueller s.n.*, Austr. felix, LE (fl.)!]

Haloragis heterophylla var. *pinnatifida* (A. Gray), Maiden & Betche, Census N.S. Wales Pl. (1916) 158.

Haloragis ceratophylla auct non Endl.: Benth., Fl. Austr. 2 (1864) 478 p.p.; Tepper, Trans. R. Soc. S. Aust. 3 (1880) 38; Tate, Trans. R. Soc. S. Aust. 3 (1880) 64, 6 (1883) 96, 12 (1889) 93; Black, Trans. R. Soc. S. Aust. 38 (1914) 467.

Haloragis heterophylla var. *ceratophylla* auct. non (Endl.) Schindler: Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 470.

Perennial herb (12-) 18-25 cm tall, perennating by very deep underground stolons; stems annual, erect, herbaceous, smooth, scabrous with simple, spreading hyaline 3-4-celled hairs, hooked at tip, 0.1-0.3 (-0.5) mm long, or rarely glabrous.

Leaves grey-green, ± glaucous, alternate (sometime opposite at base), lanceolate to narrow-ovate, length 2.0-4.0 (-5.0) cm, width (0.5-) 0.8-1.5 cm, acute at tip, tapering gradually to base, sessile, margin thickened, entire or (1-) 6-16-toothed, teeth deltoid or falco-deltoid, 0.1-0.3 cm long, midrib indistinct on upper surface, prominent below, lateral veins indistinct, hairs as for stems on both faces, hairs on margins often thicker, curved, not hooked at tip (Figs. 102-104, 106-108, 110, 111, 113-117).

Inflorescence an indeterminate spike of dichasia of (1-) 3-5 flowers in the axils of alternate primary bracts. Lateral inflorescences rarely borne in the axils of the upper leaves. Primary bracts leaflike, 1.0-1.7 cm long, 0.3-0.7 cm wide, green, fleshy, entire or serrate with 2-6 teeth, midribbed, scabrous with hairs as for stems (Figs. 105, 109, 112, 118). Secondary bracts membranous, brown to whitish, linear, 1.2-1.4 mm long, 0.2-0.3 mm wide, entire, fimbriate with hairs as for stem. Tertiary bracts membranous, brown to whitish, linear, 0.8-0.9 mm long, 0.2-0.3 mm wide, entire, fimbriate with hairs as for stem.

Flowers 4-merous, on pedicels 0.1-0.2 mm long. Sepals 4, deltoid, 1.5-1.7 mm long, 0.8-1.0 mm wide, lacking midrib, scabrous on outer face with hairs as for stem. Petals 4, red to green, hooded, tip erect, shortly unguiculate, 2.1-3.0 mm long, 0.6-0.9 mm wide (keel to margin), scabrous. Stamens 8, filaments 0.1-0.2 mm long; anthers yellow, oblong, 1.3-2.3 mm long, 0.2-0.3 mm wide, 4-locular, non-apiculate, all the same length. Styles 4, 0.2 mm long, stigmas capitate, red-purple, fimbriate. Ovary globular, 1.4-1.5 mm long, 1.0-1.5 mm wide, not ribbed, scabrous, 4-locular with 1 pendulous ovule per locule.

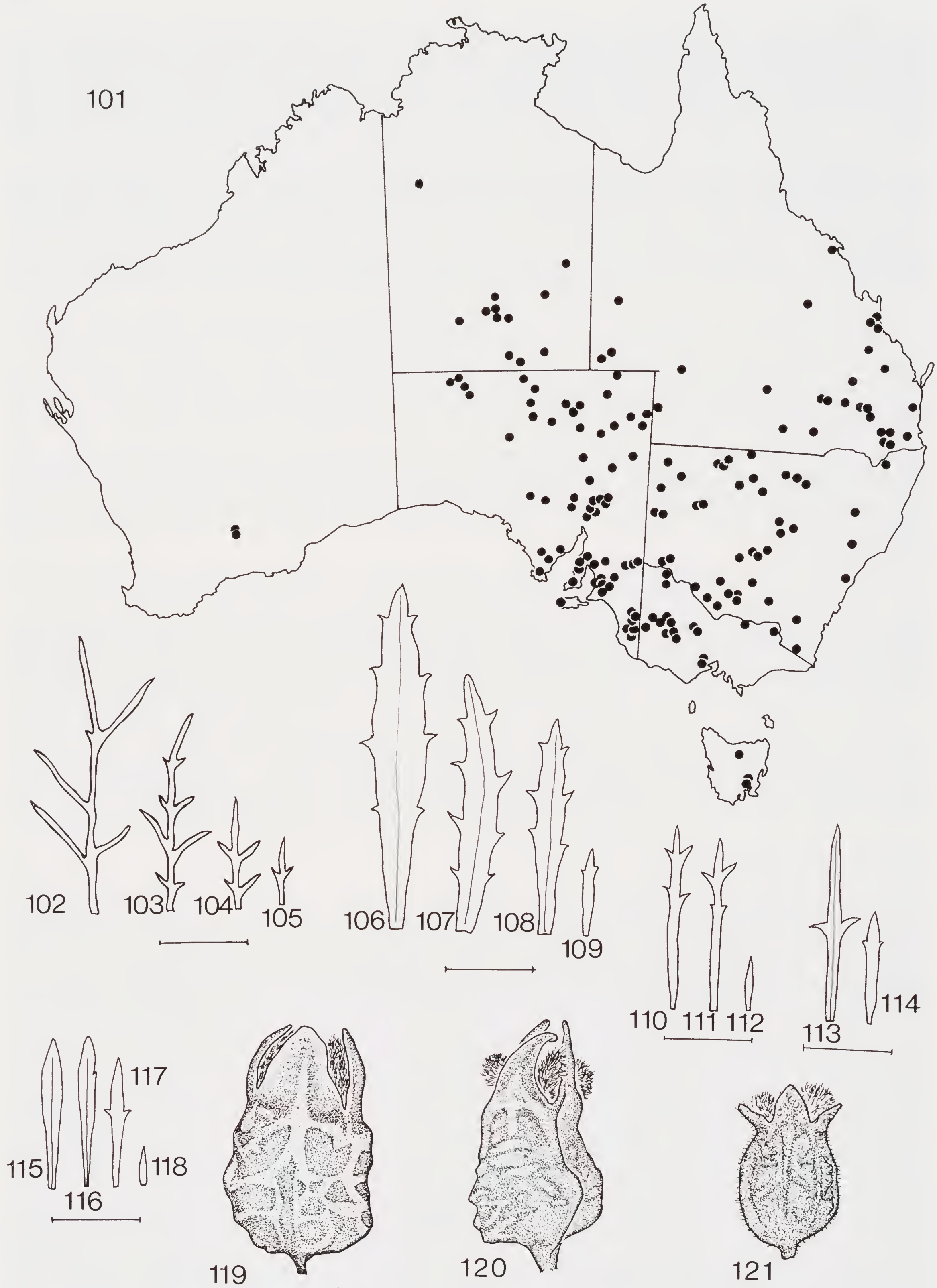
Fruits 1-3 per axil, on pedicel (0.1-) 0.3-0.6 mm long, globular to pyriform or ovoid, (2.0-) 2.5-3.0 (-4.5) mm long, (1.8-) 2.5-3.0 mm wide, ± 4- or 8-ribbed in upper part, ± smooth or rugose or verrucose in lower part, rarely glabrous, usually scabrous with hairs as for stems; sepals persistent, erect, deltoid to narrow deltoid, (0.8-) 1.0-1.5 mm long, 0.4-0.8 mm wide, usually with small median callus at base, scabrous; endocarp and septa woody, exocarp membranous, not swollen, 4-locular, 1-4 seeds (Figs 119-121).

Distribution: This species is well represented by collections from Victoria (except from Gippsland), central and western New South Wales, southern Queensland, central and southern Northern Territory, and northern and eastern South Australia. A few collections are known from Tasmania and Western Australia, and the species is known as an adventive from one locality in North Canterbury, New Zealand (Fig. 101).

Ecology: *Haloragis aspera* favours heavy clay soils which are flooded for a short time after rain. It has a deep, branching, perennial stoloniferous rootstock by which an established plant can colonise a wide area. This feature makes the plant a serious weed in cultivated ground, particularly in the Darling Downs region of southern Queensland. Collectors' notes include "depression amongst *Melaleuca lanceolata*, growing up through *Chorizandra enodis*" (*Beauglehole 29776*); "clayey sandy soil, inter-sand-ridge flats" (*Boyland 304*); "in grey clay on extensive flats flooded from Coopers Creek" (*Everist 7412*); "common in claypan forming part of creek bed between dunes" (*Orchard 757*); "Cattle appear to like eating this plant. It is a pest in our cultivation paddocks, as nothing else will thrive where it grows. It has a long root and when cut off by the plough to any usual depth merely shoots up again as sturdy as ever, and cultivation appears to improve its growth rather than hinder it." (*Tosh s.n.*, BRI080026). Flowering usually occurs from August until March (-May) and fruiting from September until May.

Specimens examined:

QUEENSLAND: Bailey s.n., -.xii.1875, Warwick, BRI079981 (fl.); *Barton 265, 267,* 1807, Armadilla between the Warrego and Marawa, MEL (fl.); *Beckler 53,* Warwick, MEL (fr.); *Bick 91,* -.xi.1910, 'Glenormiston', Georgina River, BRI (fr.); *Boorman s.n.*, -.viii.1912, Mt. Perry, NSW99095 (fl.); *Boorman s.n.*, Rockhampton, MEL39033, 39034, NSW99176 (fl., fr.); *Boyland 304,* 26.ix.1966, 56 miles [90 km] WNW of Birdsville, BRI, CANB, MEL (fl.); *Carrick 1927,* 20.viii.1968, S. bank of Coopers Creek near Nappa Merrie, AD (fl.); *Clemens s.n.*, -.x-xi.1945, BRI019035, 080023 (fl., fr.); *Clydesdale s.n.*, -.v.1950, L. Herron, Bowenville, BRI080036 (fl.); *Clydesdale 101,* 2.ix.1948, Pittsworth,, BRI (st.); *Courtice s.n.*, 15.vii.1960, Biloela, BRI024858 (st.); *Cruice s.n.*, 2.iii.1964, 'Tummaville', Yandilla, BRI051879 (fl.); *Daintree s.n.*, Kennedy district, MEL39000 (st.); *Dietrich 328,* near Gladstone, HBG (fl.); *Dietrich 422, 639,* 1863-1865, near Brisbane River, PR (fl.); *Everist 7412,* 2.viii.1963, South Galway, BRI (fl.); *Flegler s.n.*, 7.iii.1966, 8 miles [13 km] S. of Jandowae BRI063726 (fr.); *Ghent s.n.*, 27.i.1970, Campbell's Gully, Warwick, BRI091113 (fl.); *Hartmann 512,* 1875, Condamine River, BRI, MEL (fl.); *Hayward s.n.*, 24.iv.1961, Noola Plains, Brigalow, BRI (st.); *Henry s.n.*, 1889, Georgina River, MEL1003683 (fl., fr.); *Holland & Gnauck 1267,* 7.vi.1952, 'Barrington' west of Bollon, CANB (fr.); *Jackson 424,* 13.viii.1962, Nappa Merrie Station, AD (fl., fr.); *Johnson & Pedley s.n.*, 15.x.1954, Cluden, south-east of Taroom, BRI080020 (fl.); *Leichhardt s.n.*, Darling Downs, P (fl., fr.); *Maiden s.n.*, -.iii.1909, Dulacca, NSW103124 (fl.); *Noble s.n.*, 3.vii.1972, Welltown Holding, ca 45 km WNW Goondiwindi, BRI138664-5 (st.); *O'Shanesy 150,* Rockhampton, MEL1003516 (fl.); *O'Shanesy 150,* 20.viii.1867, Fitzroy River, MEL1003515 (fl., fr.); *Pollock s.n.*, 5.xii.1938, Willowvale Road, Warwick, BRI080175 (st.); *Thozet s.n.*, Rockhampton, MEL1003513 (fl., fr.); *Tosh s.n.*, 14.v.1935, Brigalow, BRI080026 (st.); *Tosh s.n.*, -.xi.1940, Brigalow, BRI080035 (fr.); *Wedd s.n.*, -.ii.1894, St. George, BRI079982 (fr.); *White s.n.*, -.xii.1912, Greenmount, BRI080012, 080013 (fr.); *White s.n.*, -.v.1916, Wallumbilla, BRI080015 (fr.); *White 3447,* 3.iii.1927, Clermont, BRI (fr.); *White 9599,* 25.x.1933, Roma, BRI (fl., fr.); *Winterton s.n.*, 30.xi.1954, Rosewood, BRI080038, CANB30338 (fr.). *NORTHERN TERRITORY: Beauglehole 27945,* 29.vii.1968, 10.7 m [17 km] NNW of Old Andado Homestead, BEAUG (st.); *Cleland 60,* -.viii.1931, Cockatoo Creek, NSW (fr.); *Giles s.n.*, -.v.1875, near Alice Springs, MEL38989 (fl., fr.); *Ising s.n.*, 24.viii.1931, Horse Shoe Bend, AD96803129 (fl., fr.); *Latz 146,* 11.ii.1968, Beenleigh Bore, Manners Creek Station, AD, AK, NT (fl., fr.); *Latz 283, 308,* 11.xii.1968, Kings Canyon, AD, AK, NT (fl., fr.); *Latz 967,* 5.xi.1970, 7 m [11 km] E. Docker River Settlement, AD (fl., fr.);



Figs. 101-121. *Haloragis aspera.* 101. Distribution. 102-104. 106-108, 110, 111, 113-117. Leaves. 105, 109, 112, 118. Primary bracts (102-105 from *Wilkes s.n.,* US; 106-109. from *Koch 295*; 110-112. from *Mitchell s.n.,* CGE; 113, 114. from *Mueller s.n.,* NSW113157; 115-118. from *Stuart s.n.,* LE). 119-121. Fruits (119. from *Nelson 1794*; 120. from *Alcock 2629*; 121. from *Symon 3283*). Scales represent 1 cm (figs. 102-118) or 1 mm (figs. 119-121).

Lazarides 5176, 5.v.1955, 9.5 miles [15 km] NNW of Alice Springs Township, CANB, NT (fl., fr.); *Lazarides 5261,* 12.v.1955, 12 miles [19 km] WSW of Argadargarda Station, BRI, CANB (fr.); *Mitchell 624,* 1846, Victoria R., CGE (fl., fr.) — holotype of *H. aspera*; *Nelson 1340,* 13.viii.1964, 0.7 m [1 km] SW Atherrita bore, Todd River Stn., NSW, NT (st.); *Nelson 1771, 1772,* 18.x.1968, C.S.I.R.O. Nursery, 7 m [11 km] SSE Alice Springs, AD, AK, NT (fl., fr.); *Nelson 1794,* 3.xii.1968, 9 m [14 km] SW of Alice Springs, AD, AK, NT (fr.); *Nelson 1849,* 13.iii.1969, Harry Creek, 32½ m [52 km] N Alice Springs, AD, AK, NT (fl.); *Orchard 757,* 13.vii.1968, Old Andado, AD (fr.); *Orchard 784,* 14.vii.1968, New Crown Station, AD (st.). *NEW SOUTH WALES: Abrahams s.n.,* -.ix.1910, Louth, NSW103146 (fl.); *Baeuerlen 121,* -.iii.1885, Delegate District, MEL (fr.); *Baeuerlen 304,* 1887, near Wilcannia, MEL (fr.); *Betche s.n.,* -.ix.1883, Bourke, NSW99204 (fl.); *Betche s.n.,* 2.x.1886, Byrock, NSW99244 (fl.); *Betche s.n.,* -.ix.1900, Paroo River District, NSW113156 (fl.) — isosyntype of *H. heterophylla* var. *glaucifolia*; *Betche 1,* 2.x.1886, Byrock, MEL38969 (fr.); *Blaxell 443,* 16.iv.1970, 32 km E. of Matakana, NSW (fl., fr.); *Boorman s.n.,* -.v.1906, Euabolong, NSW99199, 99201 (fl., fr.); *Boorman s.n.,* -.v.1906, Lake Cudgellico, NSW99088 (fr.); *Boorman s.n.,* -.ix.1912, Nulty-Toorale, AD96905129, BRI080041, NSW99198, SYD (fl., fr.); *Boorman s.n.,* -.x.1912, Arrara-Lake Eliza, AD96921172, NSW103144 (fl.); *Boorman s.n.,* -.x.1912, Wanaaring-Uriseno, NSW99200 (fr.); *Boorman s.n.,* -.i.1917, Nyngan, NSW103140 (fr.); *Bruckner s.n.,* Hillston, MEL39021 (fr.); *Campbell s.n.,* -.ii.1966, Collie, NSW99048 (fl.); *Carson s.n.,* -.iii.1887, Namoi River, MEL39132 (fl., fr.); *Clark s.n.,* -.ix.1912, Euralah via Walgett, NSW103123 (fl.); *Collier 6,* -.vii.1910, Yandama Station, NSW (fl.); *Cotter s.n.,* Cawarral, MEL38961 (fl., fr.); *Crawford s.n.,* 30.iv.1947, Leeton, NSW99183 (fr.); *Crouch s.n.,* Brookong near Urana, MEL38960 (fl.); *Dallachy & Goodwin s.n.,* Darling River, MEL38976, 39037 (fl., fr.); *Dewar s.n.,* 17.i.1971, Boolooroo, NSW132763 (fl., fr.); *Fawcett s.n.,* Richmond River, MEL39136 (fr.); *Flemons s.n.,* -.viii.1949, Trangie, NSW99179 (st.); *Forde s.n.,* Wentworth, NSW99177 (fr.); *Forde 10,* Darling River, MEL (fr.); *Forde 13,* Lower Darling, MEL (fl.); *Gauba s.n.,* 16.v.1951, Canberra, CBG013183 (fl., fr.); *Gloster s.n.,* 8.ix.1960, Albemarle Stn. via Broken Hill, ADW22705 (fl.); *Hamilton s.n.,* 8.iv.1912, Menangle, NSW99245 (fr.); *Henderson s.n.,* 10.xi.1945, banks of Wabool, NSW99193 (fr.); *Henshall s.n.,* Tapio Station 6 miles [10 km] north of Buronga, NSW113154 (fl., fr.); *Holding s.n.,* 1889, junct. of the Darling & Murray Rivers, MEL39119 (fl.); *Horan s.n.,* -.i.1913, Cudgellico via Condoblin, NSW99194 (fr.); *Jacobs 128,* 8.xi.1971, ca 62 miles [95 km] from Tibooburra on road to Adelaide Gate, NSW (fr.); *Johnson 547/124,* 1.vi.1947, Wanaaring, NSW (fr.); *Johnson & Constable s.n.,* 13.iii.1959, Edward River, Moulamein, AD96920053 (fr.); *Jones s.n.,* 19.vi.1937, Narromine, NSW99178 (fr.); *Kelk s.n.,* -.i.1908, Narromine, NSW99180 (fl.); *Kennedy s.n.,* 1886, Yandarlo via Wilcannia, MEL38963 (st.); *King s.n.,* 1887, Evelyn Creek north of Barrier Range, MEL38959, 38971 (fl., fr.); *Loveridge s.n.,* -.ii.1958, Tamworth, NSW99053 (fl., fr.); *Maiden s.n.,* 4.i.1890, Wooyeo, Cudgellico, NSW99057 (fr.); *Martensz 1765,* 20.i.1964, Tero Creek Station, CANB (fr.); *Martensz s.n.,* 1.xii.1968, l.c., CANB192876 (fl.); *Martensz 4153, 4155, 4156, 4157,* 3.xii.1968, l.c., CANB, NSW (fl., fr.); *McBarron 11274,* 13.x.1965, Bourke, NSW (fl., fr.); *McDougall s.n.,* Bourke district, NSW99087 (fl., fr.); *Mein s.n.,* Lower Edward's River, MEL39022 (fl., fr.); *Michael 796,* Kelsey Creek, BRI (fl., fr.); *Moore 5594,* 22.vi.1969, 'Tundulya' ca 40 km SE of Louth, CANB (fl., fr.); *Morris 484,* -.ii.1920, Broken Hill, NSW (fr.); *Morris 820,* 1.x.1921, Milparinka, ADW, BRI, NSW (fl., fr.); *Morwood s.n.,* 6.xi.1941, beyond Dalby, BRI080176 (fl.); *Mueller s.n.,* Bogan, MEL39024 (fl., fr.); *Mueller s.n.,* -.ix.1878, Lachlan R., MEL38970 (fl.); *Neilson s.n.,* between Darling and Coopers Creek, MEL39017 (fl., fr); *Officer s.n.,* -.ii.1904, Zara via Hay, NSW99056 (fr.); *Phelps 2, 3,* 19.x.1955, "Glen Eden", Rowena, NSW (fl.); *Rupp s.n.,* -.vi.1916, Jerilderie, MEL39049 (st.); *Schneider s.n.,* 1870, Barcoo, MEL39016 (fr.); *Smart s.n.,* 7.iv.1955, Berrigan district, NSW 99190 (fl.); *Tate s.n.,* 10.vi.1883, Depot Creek, AD96810025 (fl., fr.); *Thom 9,* -.iii.1885, Wagga Wagga, MEL (fl., fr.); *Tour s.n.,* Wentworth, MEL39009 (fl., fr.); *Toyster s.n.,* 1884, Barringun, MEL38973 (fr.); *Warren s.n.,* -.x.1907, Narromine, NSW99181 (fl.); *Whaite 1729,* 17.viii.1954, 1 mile [2 km] W. of Hay, NSW (fr.); *Whaite 1858,* 25.ii.1955, Lake Yanga, NSW (fr.); *Wilkes s.n.,* Hunter River, US47835 (fl., fr.) — holotype of *H. pinnatifida*; *Woolls s.n.,* Paramatta, MEL39081 (fl., fr.); *Wrigley s.n.,* 16.xii.1971, Lake Cargelligo to Hillston, CBG042241 (fl., fr.); *Wurfel s.n.,* -.iii.1885, Bourke, MEL38968 (fl., fr.). *WESTERN AUSTRALIA: Blackall 1221,* 30.x.1931, hills 7 miles [11 km] from Norseman, PERTH (fl.); *Gardner 2919,* 27.x.1931, Norseman, PERTH (2 sheets) (fl.). *SOUTH AUSTRALIA: Alcock 865,* 23.xii.1965, Tumby Bay, AD (fl., fr.); *Alcock 2629,* 4.ii.1969, Big Swamp, Flinders Highway, AD, ADW (fl., fr.); *Alcock 3143,* 12.xi.1969, Big Heath National Park, AD (fl.); *Andrewartha s.n.,* 25.ii.1937, Yarilla, ADW1756 p.p. (st.); *Andrewartha s.n.,* -.v.1938, Purple Downs Stn., ADW8304 (fr.); *Aston s.n.,* -.viii-ix.1961, Christmas Water, ca 32 km north of Lake Eyre North, AD96218086 (fl.); *Barker 222,* 25.ii.1968, Bryants Creek Reserve, ca 3 km NE Morgan, AD (fl.); *Barker 275,* 2.iii.1968, banks of Siccus River between Curnamona and Erudina, AD (fr.); *Beauglehole 20864,* 17.x.1966, 95 m [152 km] S. of Oodnadatta, BEAUG (fl.); *Beauglehole & Kraehenbuehl 17030,* 8.viii.1964, midway between Bordertown and Victorian-S.A. border, BEAUG (fl.); *Black 4,* 2.x.1916, Woolshed Flat, NSW (fl.); *Brummitt s.n.,* 10.xi.1892, World's End, AD96211025 (fl., fr.); *Carrick 1855,* 16.viii.1968, Murnpeowie, AD (st.); *Carrick 1872, 1880,* 17.viii.1968, 55 m [90 km] South of Innamincka, AD (fl.); *Carrick 1897,* 17.viii.1968, Coopers Creek, Innamincka crossing, AD (fl., fr.); *Cleland s.n.,* 10.xi.1892, World's End, AD96803288 (fr.); *Cleland s.n.,* 7.i.1927, Hamilton (Creek) Bore, AD966032579 (fl., fr.); *Cleland s.n.,* 13.x.1928, Aldinga Beach scrub, AD96808371 (fl.); *Cleland s.n.,* 13-14.viii.1934, south of Goyders Lagoon, AD96803287 (fl.); *Cleland s.n.,* 22.viii.1934, Karathapana Waterhole on Birdsville Track, AD96803278 (fl., fr.); *Cleland s.n.,* 4.ii.1937, Murray Bridge, AD96803303 (fl., fr.); *Cleland s.n.,* 27.v.1937, Malkia Springs, AD96808387 (fr.); *Cleland s.n.,* 5.ix.1941, Nepabunna ca 50 km east of Copley, AD96808403 (fl.); *Cleland s.n.,* 16.xii.1941, Tod River, AD96803301 (fr); *Cleland s.n.,* 12.xi.1942, Kingston, AD968020582 (fl., fr.); *Cleland s.n.,* 24.ix.1945, Rocky Hill, Ernabella, AD966032580a (fl., fr.); *Cleland s.n.,* 28.ix.1945, between Everard and Musgrave Ranges, AD96803292 (fl., fr.); *Cleland s.n.,* 1.x.1945, Oodnadatta, AD966032580b (fl., fr.); *Cleland s.n.,* 8.v.1946, Swan Reach, AD96803295 (fl., fr.); *Cleland s.n.,* 8.v.1946, Manurka, AD96803141 (fr.); *Cleland s.n.,* 25.i.1947, near Finnis Railway Station, AD 96803071 (fr. — terat.); *Cleland s.n.,* 14.xii.1949, nr Glenelg, AD968020580 (fl.); *Cleland s.n.,* 28.i.1950, Snake Lagoon, Flinders Chase, AD96803290 (fr.); *Cleland s.n.,* 13.iv.1950, Mt. Illbillie Everard Range, AD96803257 (fl., fr.); *Cleland s.n.,* 20.iv.1950, Upsan Downs, AD96803331 (fr.); *Cleland s.n.,* 28.xi.1950, Gerard near Berri, AD96803302 (fr.); *Cleland s.n.,* 15.xii.1952, Young St., Goodwood, AD96808400 (fl., fr.); *Cleland s.n.,* 1.iii.1953, Goodwood, AD96808355 (fl.); *Cleland s.n.,* 19.v.1953, Goodwood, AD96803296 (fr.); *Cleland s.n.,* 26.xi.1954, Snake Lagoon, Flinders Chase, AD96803293 (fl.); *Cleland s.n.,* 21.iv.1955, Kingston Punt, AD96803349 (fr.); *Cleland s.n.,* 17.ix.1956, Cowarie, AD96803297 (fr.); *Cleland s.n.,* 24.ix.1956, Bunyeroo, AD96803300

(fl.); *Cooper s.n.*, 3.x.1950, Wilpena Creek, Martin's Well, AD96803121 (fl.); *Copley 137*, 14.iii.1966, Section 167, Hd. of Wiltunga, AD (fl., fr.); *Copley 829*, 28.x.1966, ca 1 km north of Bute, AD (fl., fr.); *Copley 965*, 19.xii.1966, Snowtown, AD (fr.); *Copley 1072*, 19.i.1967, ca 3 km from Alford on Bute road, AD (fl., fr.); *Copley 1516*, 8.x.1967, Kingoonya, AD (fl., fr.); *Copley 2224*, 4.ix.1968, ca 65 km north of Leigh Creek, AD (fl.); *Copley 2245*, 5.ix.1968, below Yourambulla Caves, AD (fl.); *Copley 2412*, 2.xii.1968, ca 8 km from Snowtown on Bute road, AD (fr.); *Copley 2414*, 4.xii.1968, 13 km south of Bute, AD (fr.); *Copley 2429*, 23.xii.1968, ca 1.5 km east of Kadina, AD (fr.); *Copley 2482*, 5.ii.1968, Sec. 285, Hd. Koolunga, AD, AK (fl., fr.); *Copley 4144*, 4.x.1973, Warren Gorge, AD (fl., fr.); *Copley & Rowe 2535*, 5.iii.1969, Redhill, AD (fl., fr.); *Cornwall 198*, 4.vi.1972, Carmeena Rockhole ca 35 km SW Everard Park homestead, AD (fr.); *Crocker s.n.*, 7.vi.1939, flood plain of Hale River, AD96810013 (fr.); *Crocker 2*, 23.vii.1939, Warburton River, AD (fl., fr.); *Dodson s.n.*, 13.ix.1967, north-east of Mulka Homestead, AD96820161 (fl.); *Eichler 12732*, 18.ix.1956, Arcoona Creek Valley, AD (fl., fr.); *Eichler 13794*, 20.iv.1957, ca 6.5 km west of Berri, AD (fr.); *Ellis 70*, 27.i.1964, Marleston, AD (fl., fr.); *Filson 3418*, 3.x.1960, Coopers Creek, Innamincka, AD (fr.); *Giles s.n.*, 1882, near Mt. Everard, MEL39005 (fl., fr.); *Gill 241*, 19.xi.1891, north of Hergott, MEL (fr.); *Greenfield s.n.*, -.v.1935, Purple Downs Station, ADW1756 p.p. (fr.); *Hill 1202*, 22.x.1963, Siccus River Crossing, AD (fr.); *Hill 7139*, 19.iv.1946, Maitland, ADW (fr.); *Hilton 1363*, 9.iv.1955, Lyndhurst Stn., ADW (fl.); *Howitt s.n.*, 1861, Coopers Creek, MEL39027 (st.); *Hunt 378*, 11.xi.1961, ca 10 km west of Naracoorte, AD (fl.); *Hunt 528*, 9.xii.1961, ca 10 km south of Naracoorte, AD (fl., fr.); *Hunt 583*, 20.xii.1961, near Struan Creek, AD (fr.); *Hunt 1471*, 23.xii.1962, Hd. of Killanoola, AD (fl., fr.); *Hunt 1549*, 7.iv.1963, ca 10 km W. of Naracoorte, AD (fr.); *Hunt 1742*, between Keith and Padthaway, AD (fl., fr.); *Ising s.n.*, 7.ix.1931, Oodnadatta, AD96803144 (fl.); *Ising s.n.*, -.viii.1932, Hamilton River, Pedirka, AD96803143 (fr.); *Ising s.n.*, 27.x.1934, Lucindale, AD96830362 (fl.); *Ising s.n.*, 12.xii.1934, Wolseley, AD96830363 (fr.); *Ising s.n.*, -.xi.1950, Macumba Stn., AD (fl., fr.); *Ising s.n.*, 24.ix.1955, Evelyn Downs, Oodnadatta, AD96634053 (fl.); *Ising 476*, 1.x.1918, Oratunga, Moolooloo, AD (fl., fr.); *Kain 539*, -.iii.1962, Owen, ADW (fr.); *Kempe 334*, 1880, Fincke River, MEL (fl.); *Kemp 443*, 1882, Fincke River, MEL (fl., fr.); *Koch 295*, -.iii.1898 to -.x.1899, Mt. Lyndhurst, AD, BRI, K, M, NSW (fr.) — isosyntypes of *H. heterophylla* var. *glaucifolia*; *Kraehenbuehl 1800*, 23.x.1966, Freeling Cemetery, AD (fl.); *Kuchel 2510*, 17.viii.1968, ca 165 km north-east of Murnpeowie Station, AD (fl.); *Lord s.n.*, 24.iv.1950, Alberga Creek near Todmorden, MEL39041 (fr.); *Lothian 1104*, 3.x.1962, Parachilna Gorge, AD (fr.); *Lothian 2490*, 27.ix.1963, Nepabunna Mission, AD (fl.); *Lothian 2525*, 27.ix.1963, Italowie Gorge, AD (fl., fr.); *Lothian 3058*, 7.xi.1964, Pitchi Ritchi Pass, AD (fr.); *Lothian 3198*, 11.xi.1964, ca 11 km east of Angepena Homestead, AD (fl.); *Lothian 5217*, 21.ix.1972, Old Moolawatana & Poontana Creek, AD (fl.); *Lothian & Francis 473*, 27.viii.1960, 1 mile [2 km] south of Qld/S.A. border fence, AD (fl., fr.); *Millard s.n.*, Warburton River, AD96810058 (fl., fr.); *Mills s.n.*, 18.xii.1913, Woolshed Flat, NSW103154 (fr.); *Mueller s.n.*, Gawler River, MEL39008, P (fl., fr.); *Mueller s.n.*, -.x.1851, Cudnaka, MEL39018 (fr.); *Murray s.n.*, 2.iv.1930, Pernatty Station, AD96817164 (st.); *Orchard 308-319*, 14.iv.1968, bed of river Siccus on Curnamona-Artipena Springs road, AD, AK (fr.); *Orchard 321*, 14.iv.1968, Artipena Springs, AD (fr.); *Orchard 345*, 15.iv.1968, Artipena Springs, AD (fr.); *Orchard 608, 609, 610*, 27.vi.1968, ca 32 km north of Myrtle Springs H.S., AD, CHR (fr.); *Orchard 615*, 28.vi.1968, bed of Leigh Creek, AD (st.); *Orchard 616, 617, 619*, 28.vi.1968, ca 32 km west of Maree, AD (fr.); *Orchard 1842, 1843*, 29.xi.1968, bed of Siccus River, AD, AK (fr.); *Orchard 2587*, 11.x.1970, ca 10 km south-east of Curramulka, AD (fl.); *Orchard 3047*, 1.i.1971, ca 16 km west-north-west of Port Lincoln, AD (fr.); *Reid s.n.*, 11.vi.1963, Pandie Pandie Stn., ADW26433 (fr.); *Reid s.n.*, 15.x.1963, Innamincka Stn., ADW26431 (fl.); *Richards s.n.*, 1889, Mt. Ogilvie, MEL38938 (fr.); *Ridgeway s.n.*, 21.i.1971, Mortlock Expt. Stn., ADW38908 (fr.); *Rogers s.n.*, -.x.1915, Moolooloo Station between Beltana & Blinman, NSW (fr.); *Rohrlach 74*, 31.i.1959, ca 25 km south of Kimba, AD (fr.); *Smith 1146*, 3.xi.1968, Helmsdale, Glenelg East, AD (fl., fr.); *Smith 1177*, 8.v.1968, Ascot Park, AD (fl., fr.); *Smith 1199*, 29.x.1970, Goodwood, AD (fl.); *Spooner 396*, 22.iii.1969, Gascoyne Ave., Hillcrest, AD (fl., fr.); *Spooner 1264*, 23.x.1970, Valley View, AD (fl., fr.); *Symon s.n.*, 13.xi.1958, Winulta Post Office Corner, ADW20386 (fl., fr.); *Symon s.n.*, 1.v.1962, Renmark, ADW25269 (fr.); *Symon 3283*, 13.ii.1965, Everglades Bore, ADW, CANB (fl., fr.); *Symon 5665*, 16.viii.1968, near Tingtingina on Strzelecki Creek, ADW, CANB (fl.); *Symon 7436*, 15.ix.1971, junction of Brachina & Elatina Creeks, AD, ADW (fl.); *Symon 7479A*, 17.ix.1971, Mt. Sunderland, AD, ADW (fl.); *Tate s.n.*, 5.iii.1883, Mannum, AD96810026 (fr.); *Tate s.n.*, 7.v.1894, ca 50 km north of Oodnadatta, AD96810056 (fl., fr.); *Tepper s.n.*, -.xi.1879, Muloowortie near Ardrossan, AD968061232 (fl.); *Tepper s.n.*, 25.x.1887, Freeling, AD96811111 (fl., fr.); *Tepper s.n.*, 4.ii.1888, Mt. Pleasant, AD96811102 (fr.); *Tepper 602*, 1879, Yorke Peninsula, MEL (fl.); *Tepper 809*, 1888, Yorke Peninsula, MEL (fr.); *Tepper 1124*, 12.xi.1882, Reynella Cr., Morphettvale, MEL (fl., fr.); *Tough s.n.*, 16.ii.1938, Northfield, AD966021157 (fr.); *van Dam 9*, 15.vi.1969, ca 70 km south of Kingoonya, AD (fr.); *Walter s.n.*, Tattiara country, MEL39118 (fl.); *Warren 12*, 2.ix.-, Finniss Springs, AD (fr.); *Weber 735*, 24.x.1968, Mernmerna, AD (st.); *Weber 2511*, 16.ix.1971, Mt. Sunderland, AK (fl.); *Whibley 2347*, 16.viii.1968, ca 150 km north-east of Murnpeowie, AD (fl.); *Whibley 2351*, 17.viii.1968, ca 5 km north of Tinga-Tingana, AD (fl.); *Whibley 2478*, 19.viii.1968, ca 15 km north-east of Innamincka, AD (fr.); *Whibley 2522*, 23.viii.1968, ca 20 km south of Moolawatana, AD (fl.); *Wigg s.n.*, 16.i.1958, Todmorden homestead, ADW19232 (fl., fr.); *Wollaston s.n.*, 14.x.1968, Wilpena Creek, AD96848050 (fr.). *VICTORIA: Beauglehole 17013*, -.x.1949, Little Desert, S. of Kaniva, BEAUG (st.); *Beauglehole 17014*, -.x.1948, Wail near Dimboola, BEAUG (fl., fr.); *Beauglehole 17018*, 14.iii.1951, Murray River opposite Bonnie Doon, BEAUG (fl., fr.); *Beauglehole 17032*, 8.ii.1959, Jung N.E. of Horsham, BEAUG (fr.); *Beauglehole 28396*, 17.ix.1968, Wyperfeld National Park, BEAUG (st.); *Beauglehole 29729*, 22.xi.1968, Mt. Arapiles, BEAUG (fr.); *Beauglehole 29776*, 23.xi.1968, SW side of Mt. Arapiles, BEAUG (fl.); *Beauglehole & Finck 29322*, 13.x.1968, N. side of Wyperfeld National Park, BEAUG (fl.); *Beauglehole & Willis 17033*, 16.x.1960, Hattah Lakes National Park, BEAUG (fl.); *Bissill 21*, Ravenswood, MEL39090 (st.); *D'Alton s.n.*, Nhill, MEL38977 (fl., fr.); *Davis s.n.*, 1890, Wimmera, MEL39131 (fl.); *Eckert 166*, 1890, Wimmera, MEL (fl.); *Eckert 267*, 1891, Wimmera, MEL (fr.); *Gray 4035*, 24.i.1957, Horsham Cemetery, CANB (fr.); *Green 95*, Ararat Plains, MEL (st.); *King s.n.*, 1892, Murray River, MEL1003663 (fl.); *Landy & Beauglehole 9589*, 5.xi.1960, Wyperfeld National Park, BEAUG (fr.); *Meebold 6244*, Mildura, M (fr.); *Meebold 21883*, -.xii.1936, Bacchus Marsh, AD (fr.); *Mueller s.n.*, Ovens River, LE, NSW (fl.) — lecto- and isolecto-types of *H. heterophylla* var. *rigida*; *Mueller s.n.*, Austr. felix, LE (fl.) — syntype of *H. heterophylla* var. *rigida*; *Mueller s.n.*, You-Yangs, MEL38994 (fr.); *Mueller s.n.*, Murray River, MEL39010 (fr.); *Mueller s.n.*, Wimmera, MEL39035, P (fl., fr.); *Mueller s.n.*, -.xii.1850, Murray, MEL39014,

39015 (fr.); *Mueller s.n.*, -.i.1874, Upper Hume's River at Towong, MEL39125, 39126 (fl.); *Mueller s.n.*, -.iii.1893, Ovens River, MEL1003660 (fr.); *Pye s.n.*, -.i.1913, Dookie, MEL38979 (fr.); *Reader s.n.*, 21.xii.1891, Shire of Dimboola, MEL39075 p.p. (fl.); *Reader s.n.*, 4.xi.1892, Shire of Dimboola, MEL38978 (fl., fr.); *Reader 11, 12, 14*, 19.xi.1892, near Dimboola, MEL (fl., fr.); *Reader 15, 16*, 4-6.xi.1892, Wimmera, MEL (fl., fr.); *Robbins 17110*, 1940, Derby, BEAUG (fr.); *Sullivan 3*, 12.xi.1873, Moyston, MEL (fl.); *Sullivan 7*, 14.vi.1872, Moyston, MEL (fl.); *Swindley 1557*, 21.iii.1963, "Serendip" Lara, MEL (fl.); *Walter s.n.*, Wimmera, CANB 186502 (fl., fr.); *Walter s.n.*, Grampians, CANB186503 (fl., fr.); *Walter s.n.*, -.xi.1899, Grampians, NSW113160 p.p. (fl., fr.); *Walter s.n.*, -.x.1900, Wimmera Distr., NSW9836 (fr.) — isosyntype of *H. heteropyhlla* var. *glaucifolia*; *Williamson 1447*, 5.ix.1913, Mildura, MEL (fl.). *TASMANIA: Lhotsky s.n.*, Terra de Van Dieman, G (fr.) — syntype of *H. heterophylla* var. *capreolicornis*; *Oakden 20*, 1866, between Launceston and Ross, MEL (fl., fr.); *Rodway s.n.*, -.i.1894, Jordan R., HO6678 p.p. (fr.); *Rodway s.n.*, - ix.1895, Glenorchy, HO6678 p.p. (st.); *Sonder s.n.*, V.D.L., MEL1003783 (fl.); *Stuart s.n.*, Van Diemensland, HBG, LE, MEL1003762 p.p., W (fl., fr.) — lectotype & isolectotypes of *H. heterophylla* var. *capreolicornis*. *NEW ZEALAND: Healy 50/195*, 18.iv.1950, 'Keltimore', between Reece's Road, Omihi and Motanau Road, AK, CHR (fr.); *Healy 56/4, 56/6*, 18.i.1956, 'Keltimore', l.c., AK, CHR (fl., fr.).

The choice of a lectotype for *H. heterophylla* var. *capreolicornis* was necessary because Schindler cited a number of collections after his description. Of these collections, only the Stuart sheet in LE and the Lhotsky sheet in G bore determinavit slips in Schindler's handwriting. The former was preferred as it contained both flowers and fruits and because duplicates exist in HBG, MEL and W.

The name *H. heterophylla* var. *glaucifolia* similarly required lectotypification. However, no collections cited and annotated by Schindler could be located. A Betche collection in NSW bearing the number 15 (= "Sidney Herb. 15" ?), Koch collections with the number 295 (in AD, BRI, K, M, and NSW) and a Walter collection in NSW with the number 8 (= "Sidney Herb. 8" ?) agree with each other morphologically and with the description, and can probably be regarded as isosyntypes.

The name *H. heterophylla* var. *rigida* required lectotypification because Schindler based the name on at least two different Mueller collections. The LE collection from Ovens River was chosen as lectotype because its stated locality most closely matches the one cited by Schindler, and because a duplicate exists in NSW.

The occurrence of functionally female flowers, in which the anthers are rudimentary, up to 1 mm long and indehiscent, is quite common. The flowers are irregularly distributed among normal bisexual flowers with anthers at least 2 mm long. Both types of flowers set normal fruits. On the other hand, a Maiden collection (NSW103124) appears to be functionally male, with apparently normal flowers but abortive fruits.

H. aspera is one of the most widely distributed species of the genus in Australia. As such, it acts as the nucleus for a number of satellite species, viz. *H. heterophylla, H. glauca* and *H. uncatipila*. Introgression between the satellite species is unknown but intermediates between *H. aspera* and each of the others occur to various extents.

a. Intergrade material between *H. aspera* and *H. heterophylla*.

These plants often resemble *H. heterophylla* but have broader leaf segments, with pinnatifid instead of digitate arrangement, and (sometimes) larger fruits. Examples are known from coastal New South Wales (*Fawcett MEL39139*; *Woolls MEL39081, 39087*; *Wilkes US* — "H. pinnatifida"), Victoria and south-eastern South Australia (*Beauglehole & Kraehenbuehl 17030*; *Hunt 583*).

b. Intergrade material between *H. aspera* and *H. glauca*.

These plants can resemble either parent species, having either the ± entire glaucous leaves of *H. glauca* or the toothed, greener leaves of *H. aspera,* but in either case, beset with stiff, curved (not hooked) hairs up to 0.3-0.5 mm long. Collections of these plants are particularly frequent from the River Darling and its northern and eastern tributaries in central New South Wales and southern Queensland, as well as the Lachlan and Murrumbidgee Rivers, and to a lesser extent, the River Murray. Examples include *Betche NSW99204; Boorman NSW99198, 99199; Forde 10, 13; Barton 265, 267; Beckler 53; Toch BRI080026, 080035.*

c. Intergrade material between *H. aspera* and *H. uncatipila*.

These plants have leaf shape and indumentum density intermediate between the parent species. The fruit shape and exocarp texture may also be intermediate. Examples are *Symon 2683*, *Beauglehole 10171, 25336,* and *Latz 283.*

15. **Haloragis uncatipila** Orchard (Figs. Holotype, 122-131)

Haloragis uncatipila Orchard, sp. nov.

Suffrutex perennis rotundatus 40-80 cm altus, scabrosus pilis patulis teneris simplicibus 2-3-cellularis pellucidis apice uncatis 0.1-0.5 mm longis dimidio longitudinum ipsorum distantibus. Folia alterna late lanceolata vel anguste ovata 10-20 dentata deltoidea (dentes 1-3 mm longi) sessilia (2.5-) 4.0-5.0 cm longa, 0.6-1.5 cm lata, scabra. Flores 4-merous, in spicis dichasiorum sessilium (1-) 3-5 florum. Fructus virides vel rubri vel brunnei globosi laeves vel rugulosi sessiles vel in pedicellis 1-2 mm longis, 3.5-4.5 mm longi, 4.0-4.5 (-5.0) mm lati, scabri; sepala persistentes erecta vel reflexa deltata 1.2-1.7 mm longa, 1.2-1.7 mm lata; endocarpus lignosus exocarpus sufflatus fungosus; septa lignosa loculi quattuor semina 1-4.

Holotypus: *A. E. Orchard 900,* 19.vii.1968, Northern Territory. Barkly Tableland. Stuart Highway, 14 miles (ca 24 km) north of Tennant Creek. Isolated plants 12in [30 cm] high growing in open disturbed areas in low lying, somewhat swampy red sandy loam, AD97124268 (fl., fr.)! Isotypi: NT, PERTH.

Perennial subshrub 40-80 cm tall, not clonal, forming a round bush, stems arcuate ascending, not ribbed, green to reddish; major stems ± prostrate, woody, perennial, branched; minor stems erect, herbaceous, annual, unbranched; all stems densely scabrous with fine 2-3-celled simple transparent hairs hooked at the tip.

Leaves alternate, relatively thin, sessile, broad-lanceolate to narrow-ovate, (2.5-) 4.0-5.0 cm long, 0.6-1.5 cm wide, tapering evenly and equally to each end, dentate with 10-20 deltoid, evenly distributed teeth 1-3 mm long, margin slightly revolute, midrib slightly channelled above, prominent below, lateral veins indistinct, scabrous on both surfaces with hairs as for stems (Figs. 123-125).

Inflorescence an indeterminate spike of (1-) 3-5-flowered dichasia in the axils of primary bracts. Lateral inflorescences sometimes borne in the axils of the upper leaves. Primary bracts leaflike, broad-lanceolate, 1.5-2.5 cm long, 0.5-0.8 cm wide, green, fleshy, serrate, midribbed, sessile, diminishing towards spike apex, scabrous with hairs as for stem; secondary bracts linear-lanceolate, (1.5-) 2.0-2.5 mm long, 0.2-0.4 mm wide, green, ± fleshy or membranous, entire, midribbed, scabrous on margins; tertiary bracts membranous, linear, 0.7-1.0 mm long, 0.1-0.2 mm wide, scabrous on margins (Figs. 126, 127).

Flowers tetramerous, ± sessile or very shortly pedicellate (Fig. 128). Sepals 4, deltoid to subcordate, 1.2-1.4 mm long, 1.0-1.2 mm wide, green, lacking midrib, scabrous. Petals 4, yellow to green, hooded, tip horizontal or erect, not, or very shortly, unguiculate, 2.8-3.3 mm long, 0.7-0.8 mm wide (keel to margin), scabrous-pilose on keel (Fig. 129). Stamens 8, filaments 0.2 mm long; anthers yellow to reddish, oblong, (2.3-) 2.6-3.0 mm long, 0.5 mm wide, 4-locular, nonapiculate, antisepalous anthers ca 0.4 mm shorter than antipetalous ones. Styles 4, green-reddish, clavate, 0.4-0.5 mm long, stigmas capitate, fimbriate. Ovary ovoid, 1.2-1.4 mm long, 1.2-1.5 mm wide, lacking ribs, scabrous-pilose, 4-locular with 1 pendulous ovule per locule.

Fruits 1-2 (-3) per axil, green, red or brown, slightly depressed globose, 3.5-4.5 mm long, 4.0-4.5 (-5.5) mm wide, smooth or rugulose ± sessile or on pedicel 1-2 mm long, scabrous with hairs as for stems; sepals persistent, erect or reflexed, deltoid, 1.2-1.7 mm long, 1.2-1.7 mm wide; endocarp and septa woody, exocarp swollen, spongy; 4 locules, 1-4 seeds (Figs. 130, 131).

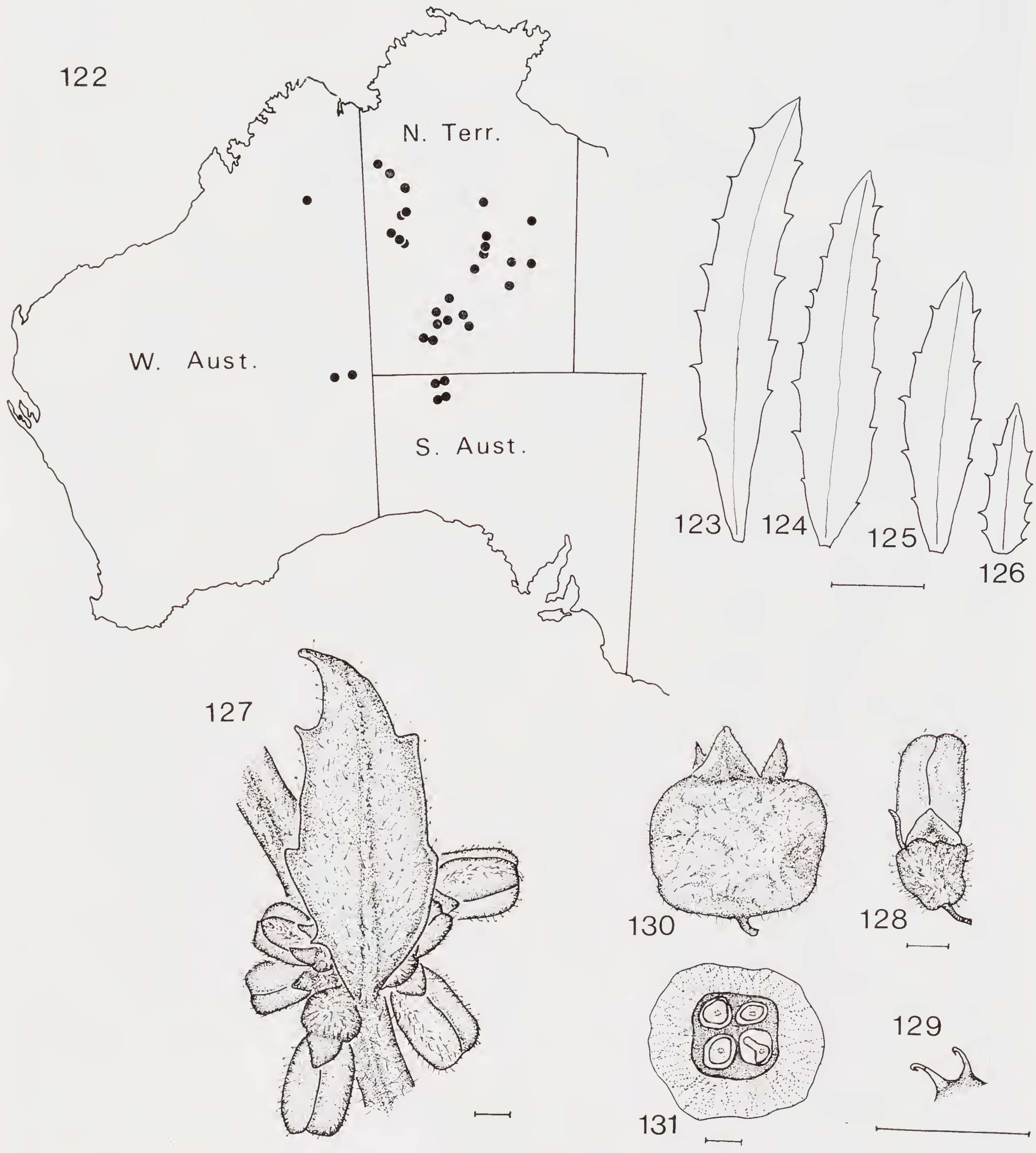
Distribution: This species is confined to central Australia. Records of its occurrence include the Everard and Musgrave Ranges of north-western South Australia, the Warburton and Blackstone Ranges of mid-eastern Western Australia, and most of southern and central Northern Territory (Fig. 122).

Ecology: *H. uncatipila* grows on a wide range of soils, avoiding only heavy clays. It is found in both mountain ranges, where creek beds are the preferred habitat, and on the plains, where it mainly occurs in naturally or artificially disturbed areas such as creek floodouts and roadsides. It is usually found in spinifex (*Triodia*) -mulga (*Acacia aneura*) associations, particularly on the plains, and usually exists as ± isolated round bushes in open situations in this community. Collectors' notes include "in red sand with spinifex and scattered shrubs" (*George 8731*), "rare on red, skeletal sand with *Eucalyptus brevifolia* and *Triodia pungens*" (*Lazarides 5875)* and "on bank of creek at bottom of gorge in black loam amongst decaying litter. Ground stony" (*Orchard 800*). Flowering and fruiting has been recorded at most times of the year, probably being dependent on the incidence of significant rainfall, but is concentrated in the period March to August.

Specimens examined:

NORTHERN TERRITORY: Beauglehole 10491, 9.vii.1965, Red Bank Gorge, BEAUG (st.); *Beauglehole 20347,* 9.x.1966, Kings Canyon, BEAUG (fl.); *Beauglehole 24181,* 24.vii.1967, Ormiston Gorge, BEAUG (fr.); *Beauglehole 26087,* 8.vii.1968, Kings Canyon, Lower Gorge, BEAUG (fr.); *Carolin 7921,* 23.viii.1970, 21 miles [34 km] north of Rabbit Flat on Tanami Road, AD (fl., fr.); *Chippendale s.n.,* 31.v.1955, 15 miles [24 km] S.E.

Holotype of *Haloragis uncatipila.*



Figs. 122-131. *Haloragis uncatipila.* 122. Distribution. 123-125. Leaves. 126. Primary bract (123-126. from *Orchard 900*). 127. Portion of inflorescence (from *Latz 754*). 128. Flower. 129. Petal hairs showing characteristic hooked tips (128, 129. from *Latz 754*). 130. Fruit. 131. Transverse section of fruit showing spongy exocarp. (130, 131. from *Orchard 900*). Scales represent 1 cm (figs. 123-126) or 1 mm (figs. 127-131).

Newland Bore, Elkedra, NT1194 (fl., fr.); *Chippendale s.n.*, 26.vi.1955, 11 m [18 km] S. Barrow Creek, BRI022084, CANB70132, MEL39047, NSW99173, NT5328 (fl., fr.); *Chippendale s.n.*, 14.vii.1956, 41 m. [66 km] S. Hookers Creek, AD96008107, CANB55769, MEL39044, NT2327 (fr.); *Chippendale s.n.*, 24.viii.1956, 40.9 m [65 km] W. Hermannsburg, CANB74497, MEL39046, NSW103117, NT2633 (fr.); *Chippendale s.n.*, 23.x.1956, 3 m. [5 km] W. Anitowa H.S., AD96534104, BRI080007, MEL48220, NSW99205, NT3147 (fr.); *Chippendale s.n.*, 21.vi.1960, 36 miles [58 km] W. Soudan, AD97049245, AK130277, NT7305 (fr.); *Cleland s.n.*, 28.viii.1950, Gosse Range, AD966042133 (fr.); *Gardner 11738*. 22.iii.1953, Standley Chasm, MEL, NT, PERTH (fl., fr.); *Gittins 2291*, -.vii.1971, 10 km from Rabbit Flat towards Tanami, BRI (fl., fr.); *Ising s.n.*, 25.vii.1936, McDonald Downs Station, AD96803157 (fr.); *Kemp 11*, -.iii.1885, James Range, MEL (fl., fr.); *Lazarides 5875*, 29.viii.1956, 30 miles [48 km] E. of Bonney Well, CANB92578 (fl., fr.); *Latz 283*, 11.xii.1968, Kings Canyon, AD, AK (fr., terat.); *Latz 754*, 4.viii.1970, 13 m. [21 km] S. Mongrel Downs Homestead, AD, AK (fl., fr.); *Must 235, 237*, 19.vii.1968, 14 m [22 km] N. Tennant Creek, Stuart Highway, AK, NT, PERTH (fl., fr.); *Must 286*, 21.vii.1968, 82 miles [131 km] S. Tennant Creek, AD, NT (fl.); *Orchard 800*, 16.vii.1968, Standley Chasm, AD (fr.); *Orchard 900*, 19.vii.1968, Stuart Highway, 14 miles [22 km] north of Tennant Creek, AD (fl., fr.) — holotype of *H. uncatipila*; *Orchard 901*, l.c., AD (fr.); *Orchard 927, 928*, 21.vii.1968, Stuart Highway, 181 miles [290 km] north of Alice Springs, AD, CHR (fr.); *Orchard 930*, 21.vii.1968, Stuart Highway, 168 miles [269 km] north of Alice Springs, AD (fr.); *Perry 2346*, 4.vii.1949, 19 miles [30 km] NNE of Inverway Station, BRI, CANB, MEL, NT, PERTH (fr.); *Perry 3512*, 22.iii.1953, Standley's Chasm, BRI, CANB, NT, PERTH (fr.); *Symon 6907*, 17.v.1971, 26 miles [42 km] SE of Tanami, AD, ADW (fr.); *Symon 6914*, 17.v.1971, 33 miles [53 km] NE of Tanami, AD, ADW (fl., fr.); *Symon 6933*, 17.v.1971, 29 miles [46 km] NE of Wilson Creek Bore, AD, ADW (fl., fr.); *Tate s.n.*, Haast's Bluff, AD96810009 (st.); *Tate s.n.*, Henbury, AD96810057 (fl., fr.); *Tate s.n.*, 1894, slopes of Mt. Sonder, AD96810041 (fl., fr.); *Tate s.n.*, 8 .v.1894, McDonald Ranges, AD96810024 (fr.); *Tietkins s.n.*, 1889, Mt. Sonder, MEL1003688, 1003689 (fr.); *van Dam 95*, 23.vi.1969, ca 170 km west of Wave Hill, AD (fl., fr.). *WESTERN AUSTRALIA: Chippendale s.n.*, 26.iii.1958, White Range, 5 miles [8 km] NW Arltunga Mission, CANB74498, NSW99171, NT4105 (fr.); *Cleland s.n.*, 26.vi.1958, Blackstone Range, PERTH (fr.); *Forrest 78*, 1874, Forrest Expedition, MEL (fl.); *George 8731*, 16.vii.1967, 4 miles [6 km] E. of Winburn Rocks, E. of Warburton Mission, AD, PERTH (fr.); *Symon 6986*, 21.v.1971, near Landringan Cliffs, AD, ADW (fl., fr.). *SOUTH AUSTRALIA: Beauglehole 10171*, 24.vi.1965, Everard Park, Illbillie Well area, BEAUG (st.); *Beauglehole 25336*, 27.vi.1968, ESE of Mt. Illbillie, BEAUG (fr.); *Cleland s.n.*, 10.viii.1933, rockhole 10 miles [16 km] north of Ernabella, AD96803308 (st.); *Cleland s.n.*, 16.iv.1950, Ernabella, AD96803330 (fr.); *McDonald* s.n., 10.ix.1968, western Everard Ranges, AD96848049 (fr.); *Symon s.n.*, 11.viii.1962, Mt. Woodroffe, AD96424155, ADW26430 (fr.); *Symon 3341*, -.ii.1965, between Betty & Ronald's Well, Everard Park Stn., ADW (fl., fr.).

Some collections from the Musgrave and Everard Ranges (e.g. *Symon 2683, Beauglehole 10171, 25336*) and from Kings Canyon, George Gill Range (e.g. *Latz 283*) are intermediate in some leaf and fruit characters between *H. uncatipila* and the (generally) more southerly *H. aspera*, suggesting some introgression between these species (see under *H. aspera*).

Specimens from the McDonnell Range (e.g. *Orchard 800, Tate AD96810024*) tend to be more densely pilose than specimens from the plains to the north, and have the sepals reflexed in the fruit instead of erect. However, collections are still insufficient to recognise these forms as distinct taxa.

As in some other species, *H. uncatipila* has some flowers functionally female by abortion of the stamens. The female flowers appear to be randomly distributed in the inflorescence.

16. **Haloragis glauca** Lindl. (Figs. 132-134)

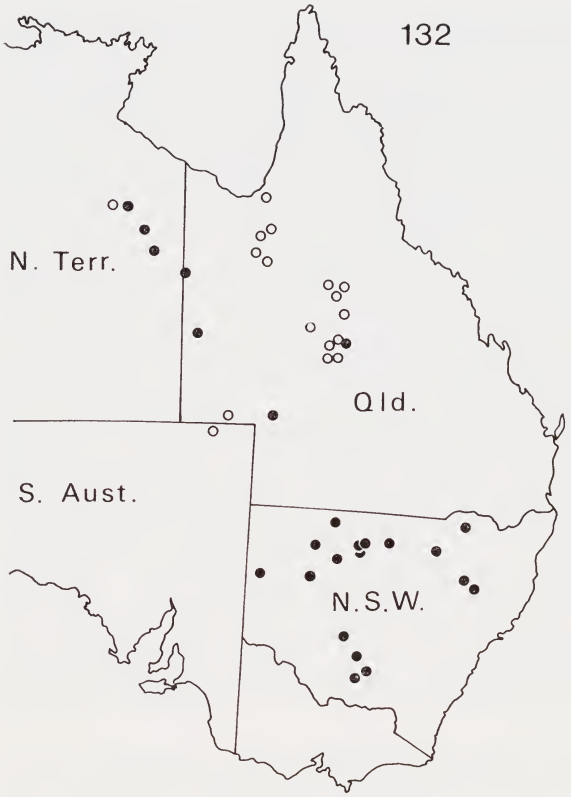
Haloragis glauca Lindley in Mitchell, J. Trop. Aust. (1848) 91 [Typus: not cited, near R. Narran. Holotypus: *Lieut.-Col. Sir T. L. Mitchell 31*, 1846, Sub-Tropical New Holland, CGE (fl., fr.)!]; Benth., Fl. Aust. 2 (1864) 479; F. v. M., Census 1 (1882) 49; Petersen, Pflfam. III. 7 (1893) 232; Schindler, Pflrch 23 (1905) 44, 45; Schindler, Feddes Repert. 9 (1911) 123; Maiden & Betche, Census N.S. Wales Pl. (1916) 158; Ewart, Fl. Vict. (1931) 884; Praglowski, Grana 10 (1970) 176; Willis, Hdbk. Pl. Vict. 2 (1970) 470.

Figs.: Schindler, Pflrch 23 (1905) fig. 13C-E; Ewart, Fl. Vict. (1931) fig. 308.

Perennial herb, 30-50 cm tall, rootstock perennial, perennating by a deep stoloniferous system, stems erect or procumbent, annual, herbaceous, sometimes rooting from lowermost nodes, smooth or weakly 4-ribbed, green to reddish, sparsely branched except at base, glaucous, glabrous or scabrous with curved, semiappressed, 1-2-celled hairs 0.1-0.2 mm long.

Leaves alternate or subopposite, narrow lanceolate to oblanceolate, (2.0-) 3.5-4.5 (-5.0) cm long, (0.2-) 0.3-0.8 (-1.1) cm wide, ± sessile or very shortly petiolate, blunt at apex, tapering gradually to base, ± entire or very finely serrulate with up to 12 teeth 0.5-1.0 mm long, midrib slightly channelled above, prominent below, lateral veins obscure, departing at 20°-35° to midrib, glaucous, scabrous on margins with very short, curved, appressed, unicellular hairs up to 0.1 mm long, glabrous on both faces or scabrous on upper surface only.

Inflorescence an indeterminate spike of 1-3 flowered dichasia in the axils of alternate primary bracts. Lateral inflorescences sometimes occur in the axils of the upper leaves. Primary bracts leaflike, green-glaucous, linear to lanceolate; secondary (and tertiary) bracts membranous, brown, linear.



Figs. 132-134. *Haloragis glauca*. 132. Distribution of the two formae of *H. glauca* (● = f. *glauca*, ○ = f. *sclopetifera*). 133. Habit of *H. glauca* f. *glauca*. 134. Fruit of *H. glauca* f. *glauca* (133, 134. from *McGillivray 2886*). Scales represent 1 cm (fig. 133) or 1 mm (fig. 134).

Flowers 4-merous, on pedicel 0.5-0.6 mm long. Sepals 4, linear-lanceolate, 1.0-1.2 mm long, 0.5-0.6 mm wide, lacking midrib, glabrous or scabrous on margins and outer face. Petals 4, green to yellow, hooded, tip erect, very shortly unguiculate, keeled, 1.8-2.6 (-3.0) mm long, 0.5-0.7 (-0.8) mm wide (keel to margin), scabrous on keel with hairs as for leaves. Stamens 8, filaments 0.1-0.2 mm long; anthers yellow, linear-oblong, 1.8-2.0 (-2.5) mm long, 0.2-0.3 (-0.4) mm wide, nonapiculate, 4-celled, antipetalous anthers 0.1-0.2 mm shorter than antisepalous ones. Styles 4, clavate, 0.2-0.4 mm long, stigmas capitate. Ovary globular to hemispherical, 0.4-0.6 (-0.8) mm long, 0.5-0.8 mm wide, ± verrucose to extremely rugose, glabrous or scabrous, 4-locular with 1 pendulous ovule per locule.

Fruit 1-2 (-3) per axil, globular to pyriform, slightly verrucose or covered in lobed appendages up to 1.5 mm long; 4-locular, 1-4 seeded.

Haloragis glauca exists as two distinct forms, which may grow together (e.g. *Perry 68, White BRI080000 & 011135*).

Key to the formae of *H. glauca*

Fruit globular to pyriform, ± 4-8-ribbed in upper part, verrucose in lower part; usually ± glabrous plants. f. *glauca*

Fruit globular or ovoid, covered with long spreading multilobed and/or simple ± woody processes up to 1.5 mm long; usually more scabrous plants. f. *sclopetifera*

f. **glauca**

Perennial herb; habit, stems as for species; leaves oblanceolate, (2.0-) 3.5-4.5 cm long, 0.6-0.8 (-1.1) cm wide, ± entire or very finely serrulate, somewhat rounded at apex, tapering gradually to base,

petiole up to 5 mm long or absent, glaucous, glabrous on both faces, scabrous on margins. Primary bracts lanceolate, 3.0-6.0 mm long, 0.5-0.8 mm wide, entire, glabrous except for margins; secondary bracts 0.5-0.7 mm long, 0.1-0.2 mm wide, entire, glabrous; tertiary bracts 0.1-0.2 mm long.

Fruit on pedicel 0.7-1.0 mm long, globular to pyriform, 2.0-2.5 mm long, 1.8-2.8 mm diam., ± 4-8-ribbed in upper part, verrucose in lower part, glabrous or rarely scabrous; sepals persistent, erect, linear, 1.1-1.2 mm long, 0.4-0.5 mm wide; 4-locules, pericarp and septa ± woody, 1-4 seeds (Figs. 133, 134).

DISTRIBUTION: This forma has a disjunct distribution, with one centre in the Barkly Tableland of north-eastern Northern Territory and north-western Queensland, and the other in central and northern New South Wales (Fig. 132).

ECOLOGY: Most collectors record this forma as growing in heavy black or grey clay soils, often in or associated with seasonal creeks. Notes include "in black soil at edge of dried waterhole in small creek" (*Latz 574*); "occasional in depression in heavy soil; grassland" (*Perry 1548*) and "common as clumps in irrigation channel" (*McBarron 11323*). Flowering plants have been collected from (January-) February until July (-October) and fruiting plants from October until June (-July).

SPECIMENS EXAMINED:

QUEENSLAND: Brass & White 337, 28.ix.1937, 20 miles [32 km] NW of Muttaburra on road to Tangorin, BRI (2 sheets), NSW (fl., fr.); *Everist 7448,* 3.viii.1963, Ingella about 20 miles [32 km] SE of Windorah, BRI (fl., fr.); *Mitchell 31,* 1846, subtropical New Holland, CGE (fl., fr.) — holotype of *H. glauca*; *Pedley 2034,* 29.v.1966, near Georgina River ca 25 miles [40 km] SSW of Camooweal, BRI (fr.); *White s.n.,* -.iv.1919, Landsborough River, BRI011135 (fr.). *NORTHERN TERRITORY; Latz 574,* 22.iv.1970, Boree Ck., Brunette Downs, AD, AK, NT (fl., fr.); *Perry 68 p.p.,* 25.vi.1947, 37.3 miles [60 km] Anthony's Lagoon — Adder W.H. — Eva Downs, CANB (fr.); *Perry 1548,* 18.vi.1948, 15 miles [24 km] WNW of Rankine River Police Station, BRI, CANB, NSW, NT, PERTH (fl., fr.); *Perry 1614,* 10.vii.1948, 15 miles [24 km] NNW of Creswell Station, BRI, CANB, NT, PERTH (fl., fr.). *NEW SOUTH WALES: Andrews s.n.,* 22.iii.1971, 14 miles [22 km] SE of Gunnedah, NSW126442 (fl.); *Beadle s.n.,* Darling R., Bourke, SYD (fr.); *Beadle s.n.,* -.v.1940, Franklin, SYD (fl., fr.); *Beadle s.n.,* -.ii.1941, Co. Franklin, SYD (fl., fr.); *Boorman s.n.,* -.xi.1903, Brewarrina, MEL38974, NSW113162 ("13") (fr.); *Boorman s.n.,* -.vi.1907, Burren Junction, NSW99055 (fr.); *Boorman s.n.,* -.x.1912, Arrara-Lake Eliza, NSW99051 (fr.); *Charley s.n.,* 21.v.1962, Fowlers Gap, NE014659 (fr.); *Coasley s.n.,* 18.xi.1946, Griffith, NSW99058 (fl.); *Constable 4643,* 27.x.1963, Buckanbee homestead, 10 miles [16 km] east of Tilpa, BISH, NSW71134 (fr.); *Forde 11,* Darling River, MEL38964 p.p. (fl.); *Green s.n.,* -.ii.1951, Gunnedah, NSW99050 (fl.); *Jacobs 64,* 4.xi.1971, Warrego R. flood plain on Bourke-Wanaaring road, NSW (fr.); *Mackay s.n.,* 1890, Clover Creek, Bourke, MEL1003666 (fr.); *Mackay 115,* 1890, Clover Creek near Bourke, MEL (fr.); *Manager, Trigg & Co. Station s.n.,* -.i.1927, Fort Burke, NSW99022 (fr.); *McBarron 11323,* 14.x.1965, 4 miles [6 km] N. of Bourke, NSW (fl.); *McGillivray 2860, 2885,* 21.xi.1967, NE edge Narran Lake, NSW (fl.); *Swain s.n.,* -.iii.1965, Yanco-Narranderra area, NSW99049 (fl., fr.); *Walker s.n.,* 12.xi.1970, 'Brigalow Park', North Star, NSW (fl.); *Whaite 1745,* 8.i.1955, 21 miles [34 km] S. of Jerilderie, NSW (fl., fr.); *Wurfel s.n.,* -.iii.1885, Bourke, MEL38967 (fl., fr.).

A number of collections from New South Wales (e.g. *Boorman s.n.,* Burren Junction, & Arrara-Lake Eliza; *Coasley s.n.*; *Forde 11*; *Manager Trigg & Co. Station s.n.*; and *Wurfel s.n.*) are more scabrous and have more prominently toothed leaves than is normal for the species, suggesting introgression with the sympatric *H. aspera, q.v.*

f. **sclopetifera** (F. v. M.) Orchard, comb. et stat. nov.

Haloragis sclopetifera F. v. Mueller, Trans. R. Soc. Vict. 24 (1888) 136 [Typus: "Norman River and Spear Creek (Th. Gulliver), and from Aramac Creek (Dr. Poulton)." Lectotypus (Orchard): *Dr. Poulton s.n.,* Aramac Creek, MEL39077 (fl., fr.); Syntypus: *T. A. Gulliver 1076,* Spear Creek, MEL39079 (fr.)!]

Haloragis tetragyna var. *glabrescens* Bailey, Qld Dept. Agric. Bull. 13 (1896) 9 [Typus: "Hab. Darr River, C. W. deBurgh Birch. Diamantina, Dr. Thos. L. Bancroft. Georgina, F.M.B." Lectotypus (Orchard): *Dr. Thos. L. Bancroft s.n.,* April 1892, Diamantina, BRI023112 (fl., fr.)! Isolectotypus: l.c., BRI023113 (fl., fr.)! Syntypi: *F. M Bailey s.n.,* Dec. 1895, Roxborough Downs, Georgina, BRI023115 (fl.)!]; *C. W. deBurgh Birch s.n.,* Darr River, BRI023114 (fl., fr.)!] Bailey, Qld Fl. 2 (1900) 556; Bailey, Comp. Cat. Qld Pl. (1913) 174.

Haloragis glabrescens (Bailey) C. T. White, Proc. R. Soc. Qld 53 (1942) 201-228 [based on *Haloragis tetragyna* var. *glabrescens* Bailey].

Perennial herb; habit, stems as for species; leaves narrow-lanceolate, 2.0-3.5 (-5.0) cm long, (0.2-) 0.3-0.6 cm wide, ± entire or serrate with up to 10 small teeth, rounded at apex, tapering gradually to base, ± sessile, glaucous, lightly scabrous (rarely glabrous) on upper surface, glabrous below, densely scabrous on margins. Primary bracts linear, 6.0-8.0 mm long, 0.7-1.0 mm wide, entire, scabrous; secondary bracts linear, 0.7 mm long, 0.1-0.2 mm wide, entire. Fruit on pedicel 1.0-2.0 mm long, ovoid, 3.0-4.5 mm long, 3.5-5.5 mm diameter, covered with long spreading multilobed and/or simple ± woody processes up to 1.5 mm long, scabrous; sepals persistent, erect, linear, 1.0-1.5 mm long, 0.5-1.0 mm wide, scabrous; pericarp and septa ± woody, 4 locules, 1-4 seeds.

DISTRIBUTION: This forma is confined almost entirely to the "Channel Country" of central and north-western Queensland. One collection is known from north-western South Australia and one from north-eastern Northern Territory (Fig. 132).

ECOLOGY: The ecological preferences of this forma are apparently very similar to those of f. *glauca*. Heavy grey or dark brown clays in or near watercourses form the usual habitat, but the plant also invades cultivated areas, spreading and perennating via its deep stoloniferous rootstock. Collectors' notes include "procumbent herb on river flats" (*Davidson 372*); "Gully in *Astrebla lappacea* grassland. Heavy dark brown soil. Wet places in rainy season." (*Hubbard 7770*); "restricted to channels where it is very common and very prominent" (*Kennedy 46*); and "on cultivated land formerly used as market garden; plant growing abundantly and pest to cultivation" (*Pearce s.n.*, BRI061804). Flowering occurs from (February-) May until August (-November) and fruiting occurs throughout most of the year.

SPECIMENS EXAMINED:

QUEENSLAND: Armit 964, Normanton, MEL39076 (fr.); *Armit 964*, Saxby River, MEL39204 (fr.); *Bailey s.n.*, -.xii.1895, Roxborough Downs, BRI023115 (fl.) — syntype of *H. tetragyna* var. *glabrescens; Bancroft s.n.*, -.iv.1892, Diamantina, BRI023112-3 (fl., fr.) — lectotype of *H. tetragyna* var. *glabrescens*; *Burbidge 5351*, 9.v.1956, Walker's Creek, SW of Hughenden, CANB (fl., fr.); *Burbidge 5374*, 11.v.1956, 20 miles [32 km] S. of Hughenden on Muttaburra Rd., CANB (fl., fr.); *Carolin 6373*, 23.viii.1967, Diamantina Lakes, SYD (fl., fr.); *Clark s.n.*, -.iii.1968, Longreach, BRI121494 (fl., fr.); *Davidson 372*, -.v.1953, 3 miles [5 km] N. of Longreach, BRI (fl., fr.); *deBurgh Birch s.n.*, Darr River, BRI023114 (fl., fr.) — syntype of *H. tetragyna* var. *glabrescens*; *Gulliver s.n.*, -.vii.1876, "Iffley" between Normanton and Cloncurry, BRI079984 (fr.); *Gulliver 1076*, Spear Creek, MEL (fr.) — syntype of *H. sclopetifera*; *Hubbard 7770*, 17.ii.1931, Marathan Station, W. of Hughenden, BRI (fl., fr.); *Kennedy 46*, Elderslie, Winton, BRI (fl., fr.); *Pearce s.n.*, 27.ix.1965, Longreach, BRI061804 (fl., fr.), *Poulton s.n.*, Aramac Creek, MEL39077 (fl., fr.) — lectotype of *H. sclopetifera*; *Poulton s.n.*, tributaries of the Thomson River, MEL39078 (fr.); *Speck 4796*, 9.viii.1954, near Dalgonally Station, AD, BRI, CANB, MEL, NSW, NT, PERTH (fl., fr.); *White s.n.*, -.viii.1916, Flinders River, BRI080002 (fr.); *White s.n.*, Landsborough River, BRI080000 (fr.); *White s.n.*, -.iv.1919, Muttaburra, BRI080003 (fr.). *NORTHERN TERRITORY: Perry 68 p.p.*, 25.vi.1947, 37.3 miles [60 km] Anthony's Lagoon-Adder W.H.-Eva Downs, CANB (fr.). *SOUTH AUSTRALIA: Cleland s.n.*, 18.viii.1934, Diamantina River at Pandie Pandie, AD96803076 & Herb. Black (fl., fr.).

The choice of a lectotype for *H. sclopetifera* was necessary as Mueller cited three different collections with the description. Poulton's collection was chosen in preference to Gulliver's specimen from Spear Creek, because the former had both flowers and fruit, while the latter bore fruit only. Gulliver's specimen from Norman River was not amongst the collections examined.

The choice of a lectotype for the name *H. tetragyna* var. *glabrescens* was necessary as Bailey cited three distinct collections in the protologue. The Bancroft collection was given preference over the other two because it consisted of superior material. Both the Bancroft and deBurgh Birch syntypes bear fruits which clearly place them in *H. glauca* f. *sclopetifera*, but the Bailey specimen has flowers only, and is cited above under f. *sclopetifera* only for convenience. White's *H. glabrescens* was based on *H. tetragyna* var. *glabrescens* and must therefore have the same type. White cited the collection *C. T. White s.n.*, -.iv.1919, Mitchell District: Landsborough River (fl., fr.) as the type of his species, but this has no formal type status. There are two sheets of this White collection in BRI; one (BRI011135), annotated "type of *H. glabrescens*" belongs in f. *glauca*, the other (BRI080000), unannotated, clearly f. *sclopetifera*. However, as White stated "The most characteristic feature [of *H. glabrescens*] is the dense covering of hard processes all over the fruits", the collection BRI011135 must be excluded from this taxon.

H. glauca is closely related to both *H. aspera* and *H. uncatipila*, but can be distinguished by its glaucous, ± entire-margined leaves and short, curved (not hooked) hairs. *H. glauca* and *H. aspera* are known to hybridise at their region of overlap in central New South Wales and southern Queensland (see under *H . aspera*).

17. **Haloragis foliosa** Benth.

Haloragis foliosa Bentham, Fl. Aust. 2 (1864) 477 [Typus: "W. Australia. Between Moore and Murchison Rivers, Drummond, 6th coll. n. 82." Holotypus: *Jas. Drummond 82*, 1853, Between Moore & Murchison Rs. W. Australia, K (fl.)! Isotypi: *Jas. Drummond 82, 6th collection*, between Moore and Murchison Rivers, CGE (fl.)!; *Drummond 82, Coll. 6.*, Nov. Holl. Swan River, G (herb. DC)!; *J. Dr. 82*, Haloragis foliosa Bth. Murchison River, MEL38956 (fl.)!; *J. Drummond 82*, Haloragis foliosa Bentham. Calyx lobes large, MEL38957 (fl.)! *James Drummond Coll. IV. n. 82*, 1859 between Moore and Murchison Rivers, PERTH (fl.)!] F. v. M. Census 1 (1882) 49, Sec. Census 1 (1889) 85; Schindler, Pflrch 23 (1905) 47. fig. 13K; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 470.

FIGS.: Schindler, Pflrch 23 (1905) fig. 13K; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 470.

Perennial herb 30-40 cm tall, stems erect, red to green, sparsely branched, smooth or weakly 5-ribbed, sparsely scabrous with simple, 3-4 celled, transparent, ± straight or hooked hairs, 0.2-0.4 mm long.

Leaves subopposite at base, becoming alternate above, sessile, linear-lanceolate, 3.0-4.5 cm long, 0.3-0.7 cm wide, serrate in upper part with 4-8 deltoid teeth 1.0-2.0 mm long, acute at tip, tapering gradually to base, midrib weakly channelled above, prominent below, lateral veins obscure, sparsely scabrous with hairs as for stems.

Inflorescence an indeterminate spike of 1-3-flowered dichasia in the axils of alternate primary bracts. Lateral inflorescences arise in the axils of the upper leaves. Primary bracts lanceolate, 0.9-1.2 cm long, 0.2-0.25 cm wide, leaflike, green, fleshy, serrate, midribbed, scabrous on margins; secondary bracts linear-lanceolate, 1.7-2.1 (-3.0) mm long, 0.4-0.7 mm wide, brown, membranous, scabrous on margins; tertiary bracts as for secondary, 1.0-1.5 mm long.

Flowers 4-merous. Sepals 4, ovate-cordate, 1.3-1.9 mm long, 1.1-1.2 mm wide, midribbed, otherwise smooth, tip very shortly acuminate, hooked hairs on margin. Petals 4, hooded, tips erect, very shortly unguiculate, keeled, 3.0-3.2 mm long, 1.0-1.3 mm wide (keel to margin), scabrous on keel. Stamens 8, filaments 0.2-0.3 mm long; anthers oblong, 2.4-2.7 mm long, 4-locular, nonapiculate, ± all equal in length. Styles 4, clavate, 0.5-0.6 mm long, stigmas capitate. Ovary hemispherical to obconical, 1.0-1.4 mm long, 0.8-1.0 mm wide, strongly 8-ribbed, scabrous with hooked hairs, 4-locular, 1 pendulous ovule per locule.

Fruits unknown.

DISTRIBUTION: This species is confined to the mid-western coastal region of Western Australia.

ECOLOGY: Nothing is recorded.

SPECIMENS EXAMINED: Known only from the type collections which are listed above.

This is a poorly known species. In most characters it agrees with *H. aspera*, with which it could be considered synonymous were it not for its broad, cordate sepals. It is also very closely related to *H. aculeolata* and *H. scoparia*. More collections, particularly fruiting specimens, are needed to ascertain the affinities and proper status of this taxon.

18. **Haloragis platycarpa** Benth.

Haloragis platycarpa Bentham, Fl. Aust. 2 (1864) 478 [Typus: "Swan River, Drummond, 1st Coll. and n. 705." Holotypus: Presumably at K, n.v. Isotypi: *Drummond 705*, 1843, Swan River, G (Herb. Boissier)! P! (st.); *Drummond 705, I coll.*, Australia, ad fl. Cygnorum, LE (fr.); *J. Dr. 705*, W.A., MEL39217, 39218, 39219 (fr.)!; *Drummond 705*, Nov. Holl. aust. occ., W (fr.)!]; F. v. M., Census 1 (1882) 49, Sec. Census 1 (1889) 85; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 31; Schindler, Pflrch 23 (1905) 48; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 469.

FIGS.: Schindler, Pflrch 23 (1905) fig. 13L-N; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 469.

Perennial (?) herb 30 cm tall, stems erect, herbaceous, profusely branched, green to red, 4-5 ribbed, glabrous except for scattered, unicellular, rounded, transparent, papillose hairs 0.1-0.2 mm long.

Leaves alternate or subopposite below, alternate above, dark green on upper surface, lighter green below, linear to narrow oblanceolate, (2.0-) 4.0-4.5 cm long, 0.4-0.5 cm wide (excluding teeth), tapering gradually to base, strongly but sparsely toothed in upper part, teeth 3-5, narrow deltoid, 2-3 mm long, midrib weakly channelled above, prominent below, glabrous.

Inflorescence an indeterminate spike of 1-3 flowered dichasia in the axils of alternate primary bracts. Lateral inflorescences borne in the axils of the upper leaves. Only the central flower of the dichasium is functional. Primary bracts leaflike, 8.0-10.0 mm long, 1.0-1.5 mm wide, green, fleshy, midribbed, serrate; secondary bracts brown, membranous, linear, 0.9 mm long, 0.2 mm wide, entire; tertiary bracts brown, membranous, linear, 0.5 mm long, 0.1 mm wide, entire.

Flowers 4-merous, on pedicels 0.2-0.3 mm long. Sepals 4, ovate, 0.6-0.8 mm long, 0.4-0.5 mm wide, not ribbed, papillose on outer face. Petals 4, hooded, tip erect, keeled, 1.7-2.0 mm long, 0.5-0.6 mm wide, glabrous or sparsely papillose on keel. Stamens 8, filaments 0.2 mm long; anthers yellow, oblong, 1.4-1.5 mm long, 0.3-0.4 mm wide, 4-celled, nonapiculate. Styles 4, clavate, stigmas capitate. Ovary depressed globose, 0.4 mm long, 0.8 mm wide, not ribbed, papillose, 4-locular.

Fruits 1 per axil, depressed globose, 1.7-2.5 mm long, 3.5-4.0 mm wide, very weakly 4-ribbed between sepals in upper part, otherwise smooth, densely minutely papillose; sepals persistent, erect, deltoid, 1.0-1.2 mm long, 1.0-1.2 mm wide, weakly midribbed, somewhat sunken into apex of fruit, sparsely papillose; fruit 4-locular, endocarp and septa woody, exocarp swollen, spongy; 1-4 seeds.

DISTRIBUTION: Known only from the Swan River district of Western Australia.

ECOLOGY: Nothing is recorded.

SPECIMENS EXAMINED: Known only from the type specimens (*q.v.*) and a Drummond collection, lacking a collector's number, date and exact locality (MEL1003719 (fl.)).

No specimen among those examined could reasonably be considered to be the holotype. There was no specimen of this species in material obtained on loan from K, and the presumed duplicate type collection in MEL had not been annotated by Bentham.

The relationships of this species are obscure. Until further collections are made, *H. platycarpa* is placed near *H. foliosa* mainly on the basis of general resemblance and phytogeography.

19. **Haloragis aculeolata** Benth. (Fig. 135)

Haloragis aculeolata Bentham, Fl. Aust. 2 (1864) 477 [Typus: "W. Australia, Clarke." Holotypus: *Mr. Clarke s.n.,* S.W. Austr., MEL38923 (fr.)! Isotypus: *Mr. Clarke s.n.,* S.W. Aust, K (ex Oldfield Hb.) Hb. Hook.!] Benth., Fl. Aust. 2 (1864) 477 sub nom. *H. tenuifolia*; F. v. M., Census 1 (1882) 49, Sec. Census 1 (1889) 85; Schindler, Pflrch 23 (1905) 53; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 471; Praglowski, Grana 10 (1970) 180.

FIG.: Blackall & Grieve, W. Aust. Wildfls 3 (1965) 471.

Erect herb 35 cm tall, stems green, weakly 4-5-ribbed, glabrous or sparsely scabrous with simple, uniseriate, curved (not hooked), 1-2-celled hairs 0.1-0.3 mm long, mainly on ribs.

Leaves alternate, linear, 2.0-2.5 (-4.5) cm long, 0.1-0.4 cm wide, sessile, ± pinnatifid with 6-8 linear teeth 1-2 mm long in upper part, midrib channelled above, prominent below, lateral veins indistinct, lamina dark green above, lighter below, scabrous, particularly on margins, with hairs as for stems.

Inflorescence an indeterminate spike of 1-3-flowered dichasia borne in the axils of alternate primary bracts. Lateral inflorescences arise in the axils of the upper leaves. Primary bracts leaflike, green, lanceolate, 0.5-1.0 cm long, 0.1-0.2 cm wide, ± entire or weakly 1-2-toothed, midrib channelled above, prominent below, scabrous on margins. Secondary bracts membranous, straw-coloured, linear, 2.0-2.3 mm long, 0.3-0.5 mm wide, ciliate on margins. Tertiary bracts membranous, straw-coloured, linear, 1.2-1.5 mm long, 0.2 mm wide, glabrous or ciliate on margins.

Flowers 4-merous, on pedicels ca 0.5 mm long. Sepals 4, ovate, 0.9-1.0 mm long, 0.6-0.7 mm wide, smooth, glabrous. Petals 4, green, hooded, nonunguiculate, 2.0-2.2 mm long, 0.6 mm wide (keel to margin), ± glabrous, or scabrous on keel. Stamens 8, filaments 0.1-0.2 mm long; anthers yellow, linear-oblong, 1.3-1.7 mm long, 0.3-0.4 mm wide, antisepalous anthers ca 0.2 mm longer than antipetalous ones, nonapiculate. Styles (1-) 2-3, clavate, 0.5 mm long, stigmas capitate. Ovary ovoid, 0.9-1.0 mm long, 0.6-1.0 mm wide, 4-ribbed, glabrous, (1-) 2-3 locular with 1 ovule per locule.

Fruits 1 per axil, on pedicel 0.5 mm long, ovoid to pyriform, 1.8-2.0 mm long, 1.5-1.9 mm wide, weakly 4-ribbed between sepals, otherwise ± smooth or slightly rugose in lower part, glabrous; sepals persistent, erect, deltoid, 0.8-0.9 mm long, 0.6-0.8 mm wide, enclosing styles, lacking midrib, sparsely scabrous on margins; fruit (1-) 2-3-locular, pericarp and septa woody, 1-3 seeds.

DISTRIBUTION: *H. aculeolata* is confined to south-western Western Australia. The only exact localities given are Cannington, a suburb of Perth, and Toolbrunup (Fig. 135).

ECOLOGY: *Meebold 9182* recorded his collection as coming from sandy heath ("Sandheide"). Flowering and fruiting occurs in December.

SPECIMENS EXAMINED:

WESTERN AUSTRALIA: Clarke s.n., S.W. Austr., K, MEL38923 (fr.) — types of *H. aculeolata*; *Meebold 7013,* -.xii.1929, Toolbrunup, M (fl., fr.); *Meebold 9182,* Toolbrunup, M (fl.); *Morrison s.n.,* 26.xii.1901, Cannington, BRI085597, CANB136636 (fl.).

The only collections of this species show marked variations in fruit structure. In the type and in the Meebold plants the fruit is 2-3-locular with an equal number of styles, while in Morrison's specimen the ovary is unilocular with a single style. The status and circumscription of this species should be reconsidered as soon as further collections are made.

H. aculeolata is most closely related to *H. hamata* from which it differs in its curved (not hooked) hairs and longer, more coarsely toothed leaves. *H. aculeolata* is probably also closely related to *H. scoparia* which differs in being glabrous and possessing a strictly 2-locular ovary and fruit.

Fig. 135. Distribution of *Haloragis aculeolata* and *H. hamata* (○ = *H. aculeolata*, ● = *H. hamata*).

20. **Haloragis hamata** Orchard (Figs. Holotype, 135)

Haloragis hamata Orchard, sp. nov.

Frutex erectus 35-55 cm altus, rami non costati vel infirme 4-5-costati in partes superae, dense pubescentes pilis tenuibus simplicibus uniseriatibus 1-2-cellularis hamatis 0.1-0.2 (-0.5) mm longis.

Folia alterna sessilia linearia ad oblonga 1.5-2.0 (-3.0) cm longa 0.15-0.25 cm lata obtusa, margines plusminusve revoluti integri vel plusminusve infirme 1-2 (-4) denticulati versus apicem, in superficiebus ambabus scabra pilis hamatis.

Inflorescentia spica indeterminata dichasiorum florum 3-5 (-7) in axillas bractearum primariarum alternarum, inflorescentiis lateralibus in axillas foliorum superorum.

Flores 4-merus, in pedicellis 0.4-0.5 (-0.7) mm longi. Sepala et petala quattuor, stamina octo, styli duo vel tres. Ovarium globosum ad hemisphaericum 2-3-loculare, ovulis in quoque loculo solitariis pendulis.

Fructus ovoideus vel depressus globosus 1.9-2.3 mm longus, 1.8-3.0 mm latus laevis vel infirme 4-costatus inter sepala, scaber 2-3-loculare septa et endocarpus plusminusve lignosus exocarpus sufflatus. Semina 2-3.

Holotypus: *A. E. Orchard 1725,* 21.x.1968, Western Australia. South West Division. Shire of Oldfield. Roadside near Location 1160 (ca 29 km north-north-east of mouth of Oldfield River), AD97044167 (fl.)! Isotypi: L, M, PE, PERTH, UC, W.

Erect perennial shrub 35-55 cm tall, rootstock a taproot with laterals, branches deep red to green, not ribbed or very weakly 4-5-ribbed in upper part, densely clothed with fine, simple, uniseriate, 1-2-celled, hooked hairs 0.1-0.2 (-0.5) mm long.

Leaves alternate, appearing to be clustered because of leafy shoots in axils, linear to oblong, 1.5-2.0 (-3.0) cm long, 0.15-0.25 cm wide, sessile, obtuse, margins ± revolute, entire or ± weakly 1-2 (-4) toothed near apex, midrib obscure above, ± prominent below, lateral veins obscure, lamina dark green above, lighter below, scabrous on both faces with hairs as for stems.

Inflorescence an indeterminate spike of 3-5 (-7)-flowered dichasia in axils of alternate primary bracts. Flowers of ultimate branchings vestigial. Lateral inflorescences arise in axils of upper leaves. Primary bracts leaf-like, green, fleshy, not or only slightly reduced compared with upper leaves, scabrous. Secondary bracts membranous, straw-coloured, linear-lanceolate, 0.7-0.8 (-1.2) mm long, 0.2-0.25 mm wide, entire, glabrous or with scattered hairs on margins. Tertiary bracts membranous, straw-coloured, lanceolate, 0.4-0.6 mm long, 0.1-0.15 mm wide, entire, glabrous.

Flowers 4-merous, on pedicels 0.4-0.5 (-0.7) mm long. Sepals 4, green, ovate to narrow-ovate, 0.7-0.8 (-1.3) mm long, 0.5-0.7 mm wide, not ribbed, glabrous. Petals 4, red-green to yellowish, hooded,

Holotype of *Haloragis hamata.*

non-unguiculate, 1.8-1.9 (-2.8) mm long, 0.6-0.7 mm wide (keel to margin), scabrous on keel. Stamens 8, filaments 0.1-0.2 mm long; anthers yellow, oblong, 1.3-1.5 (-2.3) mm long, 0.3 mm wide, 4-celled, non-apiculate, antisepalous anthers ca 0.2 mm longer than antipetalous ones. Styles 2-3, clavate, 0.3 mm long, stigmas capitate. Ovary globose to hemispherical, 0.5-0.6 (-1.5) mm long, 0.5-0.7 (-1.3) mm wide, not ribbed, densely spreading pilose with hairs as for stems, rarely ± glabrous, 2-3 locules with 1 pendulous ovule per locule.

Fruits on pedicels 0.5-0.7 mm long, ovoid to depressed-globose, 1.9-2.3 mm long, 1.8-3.0 mm wide, smooth or weakly 4-ribbed between sepals (ribs sometimes slightly swollen at base of fruit), scabrous with spreading hairs as for stems; sepals persistent, erect, deltoid, 0.9-1.0 mm long, 0.7 mm wide, enclosing styles; 2-3 locules, septa and endocarp ± woody, exocarp swollen, 1 seed per locule.

Distribution: This species is known only from the Esperance-Ravensthorpe area in south-western Western Australia (Fig. 135).

Ecology: The collections of Orchard and Eichler were found on the edge of unsealed roads through sand-plain country. *George 10484* is described as coming from "clay soil, growing along firebreak in *Euc. f ocktoniae* association." Flowering is recorded from October to November and fruiting in March.

Specimens examined:

WESTERN AUSTRALIA: Eichler 20251, 15.x.1968, ca 55 km north-north-west of Stokes Inlet, AD, PERTH (fl); *George 9830,* 7.iii.1970, ± 20 miles [32 km] SSW of Ravensthorpe, PERTH (fr.); *George 10484,* 12 xi.1970, Reserve 29860 — One Mile Rocks, between L. King and Ravensthorpe, PERTH (fl.); *Orchard 1725,* 21.x.1968, ca 29 km NNE of mouth of Oldfield River, AD, L, M, PE, PERTH, UC, W (fl.) — types of *H. hamata.*

The epithet "hamata" refers to the hairs, which are hooked at the tip. The different collections of this species show variation in minor characters. *Orchard 1725* and *Eichler 20251* are more densely and finely pilose than the George collections. The flowers of *George 10484* are larger than in the other collections, but in this respect the Orchard and Eichler collections are probably slightly immature.

H. hamata is most closely related to *H. aculeolata*, from which it can be distinguished by its hooked hairs and smaller leaves. *H. hamata* also shows relationships with *H. aspera* and *H. uncatipila*, with both of which it shares its hooked hairs, but can be distinguished by the smaller leaves and 2-3-locular ovary and fruit.

21. **Haloragis scoparia** Fenzl (Figs. 136-140)

Haloragis scoparia Fenzl, Enum. Pl. Hueg. (1837) 45 [Typus: "Swan River (Hugel.)" Holotypus: *Huegel s.n.*, Australasia. Swan River, W (fl.)! Isotypi: Swan River (Huegel), W (fl.)!; Haloragis scoparia Fenzl ! specimen authenticum, MEL39273 (fl.)!] Walp., Rep. 2 (1843) 99; Benth., Fl. Aust. 2 (1864) 477; F. v. M., Census 1 (1882) 49, Sec. Census 1 (1889) 85; F. v. M., Trans. R. Soc. Vict. 24 (1888) 133; Petersen, Pflfam. III 7 (1893) 232; Schindler, Bot. Jb. 34. Beibl. 77 (1904) 24; Schindler, Pflrch 23 (1905) 53; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 471; Praglowski, Grana 10 (1970) 178.

Loudonia scoparia (Fenzl) Hereman, Paxton's Bot. Dict. (1868) 344.

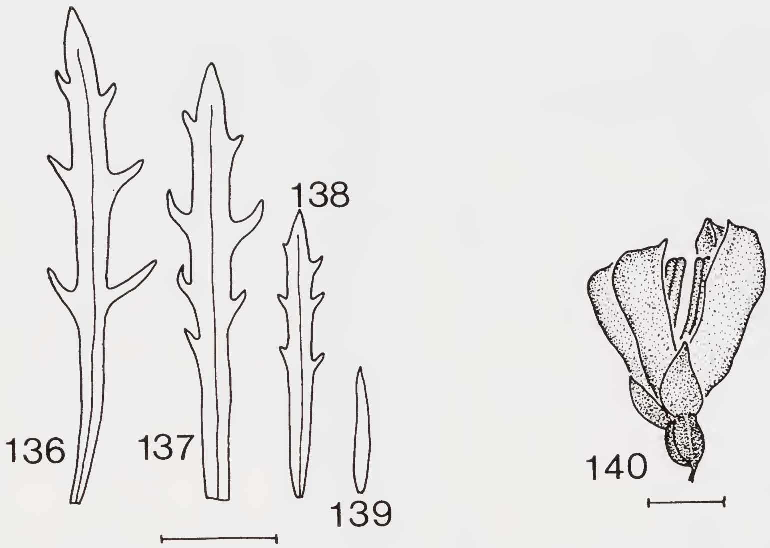
Figs.: Blackall & Grieve, W. Aust. Wildfls 3 (1965) 471; Praglowski, Grana 10 (1970) pl. 7 (c).

Perennial (?) herb 30-60 cm tall, rootstock unknown, stems herbaceous, smooth, glabrous, sparsely branched.

Leaves subopposite below, alternate above, linear to narrow-lanceolate, 4.0-6.0 (-7.5) cm long, 0.2-0.4 (-0.7) cm wide (excluding teeth), sessile, entire or sparsely serrate in upper part with 2-4 (-8) deltoid teeth 1-3 (-5) mm long, midrib obscure on upper surface, prominent below, lateral veins not apparent, glabrous (Figs. 136-138).

Inflorescence an indeterminate spike of 1-3-flowered dichasia in the axils of primary bracts. Lateral inflorescences absent or borne in the axils of the upper 3-11 leaves. Primary bracts leaflike, green, fleshy, linear, 7.0-10.0 mm long, 1.0-1.5 (-2.0) mm wide, entire, weakly midribbed, glabrous; secondary bracts brown, membranous, linear, 1.3-1.7 mm long, 0.3 mm wide; tertiary bracts brown, membranous, linear, 0.6-0.8 mm long, 0.1-0.2 mm wide (Fig. 139).

Flowers 4-merous,, on pedicel 0.5-0.7 mm long. Sepals 4, ovate, 0.9-1.0 mm long, 0.7-0.8 mm wide, lacking midrib, glabrous. Petals 4, hooded, tip erect, keeled, 1.7-2.1 mm long, 0.6-0.7 mm wide (keel to margin), glabrous. Stamens 8, filaments 0.3 mm long; anthers yellow, oblong, 1.8-2.0 mm long, 0.3-0.4 mm wide, 4-celled, nonapiculate, antipetalous anthers ca 0.2 mm shorter than antisepalous ones. Styles 2, clavate, 0.5-0.6 mm long, stigmas capitate. Ovary ovoid, 0.8-0.9 mm long, 0.7-0.9 mm wide, not ribbed, glabrous, 2-locular with 1 pendulous ovule per locule (Fig. 140).



Figs. 136-140. *Haloragis scoparia.* 136-138. Leaves. 139. Primary bract. 140. Flower (136-140. all from *Drummond 82*). Scales represent 1 cm (figs. 136-139) or 1 mm (fig. 140).

Fruits 1 (-2) per axil, ovoid, 1.9-2.4 mm long, 1.5-1.7 mm wide; 4-ribbed between sepals, ribs very weakly membranous-winged in central part, body of fruit weakly transversely rugose in lower part between ribs; sepals persistent, erect, deltoid, 0.9 mm long, 0.8 mm wide, lacking midrib; 2 locules, pericarp and septum ± woody, 1-2 seeds.

Distribution: This species is known only from the Swan River district near Perth, Western Australia.

Ecology: Nothing is recorded about habitat preference, soils, etc. Drummond's collection in G (Hb. Deless.) has July as the date of collection, and bears both flowers and fruits.

Specimens examined:

WESTERN AUSTRALIA: Drummond s.n., W.A., MEL39272, 39301 (fl., fr.); *Drummond 4th coll. 82,* -.vii.1848, Swan River, G (Herb. Boissier, Herb. Deless.), MEL39271, NSW99278, 99279, P (fl., fr.); *Huegel s.n.,* Swan River, MEL39273, W (2 sheets) (fl.) — types of *H. scoparia.*

Drummond's collection (NSW99279 ex W) has some flowers with only a single style and 1-locular ovary.

The relationships of this species are probably with *H. aculeolata* and (possibly) *H. foliosa.* More collections are needed to clarify the position.

22. **Haloragis heterophylla** Brongn. (Figs. 141-146)

Haloragis heterophylla Brongniart in Duperrey, Voy. Coq. Bot. (1829-1834) t. 68A [Typus: none cited. Holotypus: *D'Urville s.n.,* Port Jackson, P (fl., fr.)!] Gray, Bot. U.S. Expl. Exped. 1 (1854) 627; Benth., Fl. Aust. 2 (1864) 478, 483; Tate, Trans. R. Soc. S. Aust. 3 (1880) 64; F. v. M., Census 1 (1882) 50, Sec. Census 1 (1889) 86; Bailey, Synop. Qld. Fl. (1883) 157; F. v. M., Key Syst. Vict. Pl. 2 (1885) 22, 1 (1887-8) 262; Field Nats., Trans. R. Soc. S. Aust. 8 (1885) 185; F. v. M., Trans. R. Soc. Vict. 24 (1888) 135; Tate, Trans. R. Soc. S.. Aust. 12 (1889) 95; Tate, Fl. S. Aust. (1890) 101, 234; Moore Hdbk. Fl. N.S. Wales (1893) 185; Bailey, Qld. Fl. 2 (1900) 554, 555; Schindler, Bot. Jb. 34. Beibl. 77 (1904) 31; Schindler, Pflrch 23 (1905) 45, 46; Dixon, Pl. N.S. Wales (1906) 129, 130; Bailey, Comp. Cat. Qld. Fl. (1913) 174; Maiden & Betche, Census N.S. Wales Pl. (1916) 158; Black, Fl. S. Aust. (1926) 430; Domin, Bibl. Bot. 89 (1929) 1034; Black, Fl. S. Aust. (1952) 643; Evans, in Beadle, Evans & Carolin, Hdbk. Vasc. Pl. Syd. Dist. (1963) 174; Eichler, Suppl. Black's Fl. S. Aust. (1965) 245; Burbidge & Gray, Fl. A.C.T. (1970) 279; Willis, Hdbk. Pl. Vict. 2 (1972) 469; Beadle et al., Fl. Syd. Reg. (1972) 206.

Haloragis ceratophylla Zahlbr. ex Endl., Atakta Bot. (1834) 16 [Typus: "Crescit in Novae Hollandiae orae occidentalis sinu Schoalwater Bay dicto. (Ferd. Bauer)". Holotypus: Endl., l.c., t. 15 (del. Bauer)!] Fenzl, Enum. Pl. Hueg. (1837) 45; Walp., Rep. 2 (1843) 99; Benth., Fl. Aust. 2 (1864) 478, 479, 483; F. v. M., Census 1 (1882) 49; Bailey, Synop. Qld. Fl. (1883) 156; F. v. M., Key Syst. Vict. Pl. 2 (1885) 22; Bailey, Qld. Fl. 2 (1900) 554.

Haloragis filiformis A. Gray, Bot. U.S. Expl. Exped. 1 (1854) 628 [Typus: "Hab. New South Wales; in the vicinity of Hunter's River." Holotypus: *Wilkes s.n.,* Hunter's River, New South Wales, US47834 (fl., fr.)!]

Haloragis heterophylla var. *filiformis* (Gray) Bentham, Fl. Aust. 2 (1864) 483.

Haloragis heterophylla var. α *ceratophylla* (Endl.) Schindler, Pflrch 23 (1905) 46; Maiden & Betche, Census N.S. Wales Pl. (1916) 158.

Haloragis heterophylla var. β *capreolicornis* [non Schindler] Schindler, Pflrch 23 (1905) 46 p.p. [Typus: Comprising those syntypi (and other specimens determined by Schindler) of *H. heterophylla* var. *capreolicornis* Schindler which differ from the lectotypus, and are therefore excluded from that varietas (*q.v.*, sub. *H. aspera*)] Britten, J. Bot. 45 (1907) 136; Praglowski, Grana 10 (1970) 176.

Haloragis heterophylla var. *linearis* Black, Fl. S. Aust. 2 ed. (1952) 643, nom. inval. (vide Eichler, Suppl. Black Fl. S. Aust. (1965) 245 pro nom. inval.).

Figs.: Brongn. in Duperr., Voy. Coq. Bot. (1829-1834) t. 68A; Endl., Atakta Bot. (1834) t. 15; Burbidge & Gray, Fl. A.C.T. (1970) fig. 270.

Annual or perennial herb, perennating from a deep lateral rootstock, stems erect, (15-) 25-50 cm tall, green, herbaceous, 4-ribbed, scabrous with simple, 2-3-celled, hyaline, spreading hairs, 0.2 mm long and hooked at the tip, or rarely glabrous. Leaves opposite or alternate, sessile (linear-), trifid to multifid in upper half, divisions digitate or successive, margins entire, segments (and undivided lamina) 1.2 mm wide, acute, lamina (incl. segments) broadly spathulate, (1.0-) 1.5-3.0 cm long, 0.5-1.0 (-2.0) cm wide, midrib weakly developed in undivided part, scabrous with hairs as for stems (Figs. 142-144).

Inflorescence an indeterminate spike of 1-3 (-4)-flowered dichasia borne in axils of primary bracts. Lateral inflorescences occur in axils of upper leaves. Primary bracts linear, (3.0-) 4.5-5.0 mm long, 0.5-0.7 mm wide, margins entire, green, fleshy, midrib absent, scabrous with hairs as for stems; secondary bracts membranous, brown, linear, 0.3-0.6 mm long, 0.1 mm wide, scabrous on margins (Figs. 145, 146).

Figs. 141-146. *Haloragis heterophylla*. 141. Distribution. 142-144. Leaves. 145. Primary bract. (142-145 from *Wilkes s.n.*, US). 146. Portion of infructescence showing two young fruits (from *Brongniart s.n.*, P). Scales represent 1 cm (figs. 142-145) or 1 mm (fig. 146).

Flower 4-merous. Sepals 4, narrow-deltoid, 0.8-1.2 mm long, 0.3-0.5 mm wide, not ribbed, scabrous. Petals 4, hooded, tip erect, shortly unguiculate, 2.2-2.8 mm long, 0.6-0.8 mm wide (keel to margin). Stamens 8, filaments 0.1-0.2 mm long; anthers red, oblong, 1.3-1.5 (-2.4) mm long, 0.2-0.4 mm wide, 4-locular, nonapiculate, all equal in length. Styles 4, clavate, stigmas capitate, reddish. Ovary globular, 0.6-0.8 mm diam., lacking ribs, scabrous, 4-locular, with 1 ovule per locule.

Fruits 1-2 per axil, pedicellate on stalk 0.5-0.7 mm long, pyriform, body of fruit 1.5-2.4 mm long, 1.3-1.8 mm wide, longitudinally 4-ribbed between sepals, irregularly or ± transversely wrinkled in the lower part, ± smooth in the upper part; sepals erect, ± enclosing styles, 0.8-1.2 mm long, 0.4-0.6 mm wide; exocarp slightly woody, 1-4 seeds (Fig. 146).

Distribution: This species is widespread in Victoria (except the extreme north-west), eastern New South Wales and eastern Queensland. It is rare in South Australia, being confined to a few localities in the south-east and in the southern Mt. Lofty Range. Only 3 specimens from Tasmania have been located, 1 from near Hobart and 2 from near Launceston (Fig. 141).

Ecology: *H. heterophylla* is largely confined to the wetter temperate regions of the east coast. Within this region, the plants are usually found in creek beds or swampy areas, and can be a serious weed in pastures or crops. Little preference for particular soil types is apparent. Collectors' notes include "a weak growing herb, growing in permanent moist places amongst *Cyperus*, sedges, etc." (*Boorman NSW99223*), "on banks of moist gully" *(Everist & Webb 1383)*, "common in very wet peaty habitat in pasture" *(Hoogland 3104)*, "occurs in patches in a cult. paddock & has an extremely deep rooting system which has rendered the area useless for growing annual crops. It is growing in heavy clay soil" (*Johnson NSW99233*), "sandy soil" *(Leigh S289)*, "dark grey sandy loam, more or less swampy" (*Moore 2418*), "deep yellow podsolic soil on porphyry & sed. shale" (*Moore 2769*), "¼ acre patch in grain sorghum paddock in heavy chocolate soil" (*Speed NSW99229*), and "in brown loam on grassy hill with *Eucalyptus tesselaris* and *Eucalyptus melanophloia*" (*Everist 7612*). Flowering occurs from (October-) November until January (-May) and fruiting from November to March (-May).

Specimens examined:

QUEENSLAND: Armit 847, Mt. Surprise, MEL (fl., fr.); *Bailey s.n.,* Brisbane, BRI080009 (fr.); *Bailey s.n.,* Brisbane River, BRI080011, CHR114019 (fl., fr.); *Bailey s.n.,* -.x.1875, Brisbane River, BRI080029 (fl., fr.); *Beckler s.n.,* Warwick, MEL39082, 39105, 39137 (fl., fr.); *Biddulph s.n.,* Nagoa River, MEL39130 (fr.); *Blake 2829,* -.x.1951. Petrie, BRI fl.); *Boorman s.n.,* -.xi.1904, Stanthorpe, NSW99223 (fl., fr.); *Bowman s.n.,* 1870, Herbert River, MEL39067 (fr.); *Brown s.n.,* Kebbell [= Keppell] Bay, MEL39065 (fl.); *Domin 7415,* -.iii.1910, Mt. Remarkable, PR (fl., fr.); *Domin 7416,* -.ii.1910, Pentland, PR (fl., fr.); *Dovey 205,* 27.ix.1933, Rosedale, BRI (fl.); *Eichler 20737,* 8.vii.1970, Nordello's Lagoon near Walkamin, AD (fl., fr.); *Everist 6162,* 8.ii.1960, Strathgarve BRI (fl., fr.); *Everist 7612,* 17.xi.1963, Byron Creek ca 30 km E.N.E. of Esk, BRI (fl.); *Henderson H384,* 7.iii.1968, Strathgarve, 34 km S. of Warwick, CANB, BRI, MEL (fl., fr.); *Henderson H392,* 7.iii.1968, Applethorpe, BRI (fl., fr.); *Henderson et al. 812,* 24.iv.1971, Blackdown Tableland, BRI (st.); *Hubbard 4092,* 20.ix.1930, near Kuraby, BRI (fl.); *Hubbard 5134,* 17-18.xi.1930, on top of Main Range near Gurulmundi, BRI (fr.); *Jackes s.n.,* 13.iv.1964, top of Mt. Stuart, Townsville, Herb. Uni. College of Townsville (fr.); *Kenny s.n.,* 1.xi.1906, Gympie, BRI (fl.); *Keys 127,* Mount Perry, BRI (fl., fr. — terat.); *Leichhardt s.n.,* Moreton Bay, MEL39096 (fl.); *Leichhardt s.n.,* 20.i.1844, Durral, Moreton Bay, P (fl., fr.); *Longman s.n.,* -.i.1911, Toowoomba. NSW99217 (fl., fr.); *Martin s.n.,* 13.v.1962, Carinya, north of Mitchell, BRI038525 (fl., fr.); *Martin s.n.,* 21.v.1962, Hodgson, near Roma, BRI033107 (fl., fr.); *Meebold 3923,* -.iv.1929, Stanthorpe, M (fl., fr.); *Morain 267,* 4.i.1968, ca 45 miles [72 km] S.E. of Mt. Garnet, BRI (fl.); *Mueller s.n.,* Burdekin River, MEL39095 (fl., fr.); *O'Shanesy 149,* 20.viii.1867, Rockhampton, MEL (fl.); *Pedley 981,* 18.iv.1962, 23 miles [37 km] south-east of Texas, BRI (fl., fr.); *Smith 774,* 29.i.1940, Racecourse Creek N.E. of Wallangarra, BRI (fl., fr.); *Stuart 72,* Nov., Moreton Bay, MEL (fl.); *White s.n.,* 9.x.1909, Brisbane, Coopers Plains, BRI080010 (fl., fr.); *White s.n.,* 1.vii.1916, Upper Brisbane River, BRI079985, NSW99218 (fl., fr.); *White s.n.,* -.x.1916, Chermside near Brisbane, BRI080025 (fl., fr.); *White s.n.,* -.x.1921, Crow's Nest, BRI080016 (fl.). *NEW SOUTH WALES: Althofer s.n.,* -.xii.1970, Burrendong Arboretum, NSW132762 (fl.); *Baeuerlen s.n.,* -.xi.1891, Ballina, NSW99230 (fl., fr.); *Baeuerlen 218,* -.xii.1886, Monaro district, MEL (fl.); *Baeuerlen 227,* -.xii.1886, Twofold Bay district, MEL (fl., fr.); *Baeuerlen 294,* -.xii.1884, Braidwood district, MEL (fl.); *Beadle s.n.,* 1.xii.1950, Co. Forbes, SYD (fl.); *Beckler s.n.,* Clarence River, MEL39103 (fr.); *Beckler s.n.,* River Arne, MEL39094 (fr.); *Beeton s.n.,* 30.iii.1962, near Royal Canberra Golf Course, CBG014045 (fl., fr.); *Betche s.n.,* 29.x.1886, Glen Innes, NSW113153 ('11a') (fl.) — syntype of *H. heterophylla* var. *capreolicornis; Betche s.n.,* -.xii.1891, Wallangarra, NSW99226 (fl.); *Betche 9,* -.i.1888, Michelago, NSW (fl., fr.); *Bonton 20,* 1890, Lachlan River, MEL (fl.); *Boorman s.n.,* -.xi.1900, Tuggerah, NSW113152 ('10') (fl.) — syntype of *H. heterophylla* var. *capreolicornis*; *Boorman s.n.,* -.xi.1906, Manildra, NSW99085 (fl., fr.); *Boorman s.n.,* -.xii.1907, Blayney, AD96921187, NSW103147 (fl.); *Boorman s.n.,* -.i.1908, Orange, NSW 103142 (fl., fr.); *Boorman s.n.,* -.v.1914, Wallangarra, NSW99225 (fr.); *Boorman s.n.,* 28.i.1918, Wallangarra, AD96920068 (fr.); *Breakwell s.n.,* -.xii.1913, Moruya, NSW98999 (fl., fr.); *Breakwell s.n.,* -.xi.1914, Glen Innes, NSW99212 (fl., fr.); *Brown 4430,* Iter Australiense [Port Jackson], MEL (fl., fr.); *Burbidge & Gray 6105,* 18.xii.1958, 7 m. [11 km] from Kambah Pool turnoff on Tharwa Rd., A.C.T., CANB (fl., fr.); *Burbidge & Gray 6130,* 18.xii.1958, lower slopes of Mt. Tennant. A.C.T., CANB (fl., fr.); *Caley s.n.,* Nova Holland, NSW113151 (st.); *Caley s.n.,* Parramatta, UPS (fl.); *Campbell s.n.,* 1882, New England, MEL39059 (fl., fr.); *Campbell s.n.,* -.xi.1906, Wollar, Mudgee, NSW99084 (fl., fr.); *Carter s.n.,* -.i.1885, Moonan Brook, Hunters River, MEL39073 (fl.); *Cleland s.n.,* 25.xi.1916, Pilliga scrub, Narrabri, AD96905114 (fl., fr.); *Congrave 7,* 1893,

sources of the Lachlan River, MEL (fl., fr.); *Crawford 398,* -.i.1885, Moona Plains, Walcha, MEL (fl., fr.); *Crawford 527,* 4.iii.1885, Moona-Walcha, MEL (fl., fr.); *Cutting 4,* 4.iv.1955, Cootamundra district, NSW (fl., fr.); *Davis 2,* Dumaresq Creek, Armidale, NSW (fl., fr.); *D'Urville s.n.,* Port Jackson, P (fl., fr.) — holotype of *H. heterophylla; Eaves s.n.,* Broadwater, MEL39113 (fl.); *Evans s.n.,* -.xii.1925, Mt. Druit, SYD (fl.); *Evans s.n.,* -.i.1950, E. of Orange, SYD (fr.); *Everist & Webb 1383,* 23.xi.1946, near Maryland River on Stanthorpe-Woodenbong road, BRI, CANB (fl.); *Gauba s.n.,* Canberra, A.C.T., CBG013183 (fl., fr.); *Golsby s.n.,* -.xii.1916, Bumbaldry, NSW99216 (fl., fr.); *Hazes 12,* -.iii.1908, Ashford, NSW (fl., fr.); *Herrington s.n.,* 10.iii.1954, Scone, NSW99241 (fl., fr.); *Hickey s.n.,* -.xii.1884, Maryland, MEL39053 (fl.); *Hoogland 3104,* 20.xii.1952, near Tidbinbilla Homestead along Hurdle Creek, A C.T., CANB (fl.); *Johnson s.n.,* -.iii.1953, Cooninoo, Moree, NSW99233 (fl.); *Lamont s.n.,* mouth of Clarence River, MEL1003744 (fl., fr.); *Leigh S289,* 3.xii.1964, Milewa State Forest, 25 miles [40 km] S. of Deniliquin, NSW (fl., fr.); *Maiden & Boorman s.n.,* -.xii.1903, Jennings, NSW9835 ('6') (fl.) — syntype of *H. heterophylla* var. *capreolicornis*; *Mair s.n.,* 23.x.1951, Dripstone, NSW99240 (fl.); *Mair 113,* 23.xii.1931, C.S.I.R.O. paddock, A.C.T., CANB (fl., fr.); *Marshall s.n.,* 7.i.1947, Gowrie via Tamworth, NSW99221 (fl.); *McBarron 810,* 5.iv.1947, The Glen-Tumbarumba, NSW (fl., fr.); *McBarron 2588,* 17.xi.1948, Walla Walla rd., Gerogery, NSW, SYD (fl.); *McBarron 2768,* 8.xii.1948, Bungowannah, NSW (fl.); *McBarron 3304,* 15.v.1949, Gerogery, NSW, SYD (fl., fr.); *McBarron 14891,* 10.ii.1968, Minto, NSW (fl.); *McBarron 14919,* 22.ii.1968, Wilde's Meadow near Robertson, NSW (fl.); *McBarron 14961,* 22.ii.1968, Glenquarry nr. Moss Vale, NSW (fl., fr.); *McKee s.n.,* 18.i.1948, Ben Lomond, NSW99228 (fl., fr.); *McKee 407,* 4.xi.1952, Boree, 20 m. [32 km] W. of Orange, SYD (fl., fr.); *Moore 2418,* 11.iii.1953, swamp at N. end of L. George, CANB (fl., fr.); *Moore 2769,* 10.xi.1953, 10 miles [16 km] from Canberra on Yass Rd., CANB (fl.); *Moore 2810,* 30.xi.1968, Yass-Boorowa, 6 miles [10 km] from Hume Highway, CANB, NSW (fl, fr.); *Mueller 51,* Illawarra, MEL1003655 (fl.); *Paltridge 203,* 28.xi.1931, Glen Elgin, CANB (fl.); *Perrott s.n.,* New England, MEL39069 (fr.); *Perrott s.n.,* 1871, Armidale, MEL39122 (fr.); *Rupp s.n.,* -.xi.1913, Sydenham, Barraba, MEL39048 (fl.); *Rupp 9,* -.i.1907, Warialda, NSW (fl., fr.); *Rupp 18,* 29.i.1914, Bolivia, NSW (fl., fr.); *Rupp 19,* 29.i.1914, Glen Innes, NSW (fl., fr.); *Roe AR696,* 20.iv.1950, Chiswick, Armidale, CANB, NE (st.); *Salasoo 2929,* 29.xii.1964, ca 1 mile [2 km] NW of Grenfell, NSW (fl., fr.); *Schultz s.n.,* 1951, Penrith, SYD (fr.); *Speed s.n.,* 22.xi.1966, Gunnedah, NSW99229 (fl.); *Stuart 245,* New England, MEL39133 (fl.); *Wenholz s.n.,* -.iii.1913, Glen Innes, NSW99238 (fl.); *White s.n.,* 6.xii.1951, Bloomfield, Orange, NSW99239 (fl.); *White-Haney 62D76,* 25.ii.1930, Glen Elgin, CANB (fl., fr.); *Wilkes s.n.,* Hunter's River, US47834 (fl., fr.) — holotype of *H. filiformis*; *Woolls s.n.,* Cumberland County, MEL39083 (fl., fr.); *Woolls s.n.,* Paramatta, MEL39106 (fr.); *Yarrington s.n.,* nr. Maitland, NSW99222 (fr.). *SOUTH AUSTRALIA: Anon s.n.,* Grunthal [= Verdun], AD96810027 (fr.); *Behr s.n.,* Barossa, MEL1003762 (fl.); *Behr s.n.,* -.i.1849, Barossa Range, MEL39104 (fl.); *Cleland s.n.,* 17.ii.1948, Horr's Drift ca 15 km west of Mt. Schank, AD96803069 (fr.); *Cleland s.n.,* 17.ii.1948, Rork's Drift ca 9 km west of Mt. Schank, AD (fl., fr.); *Cleland s.n.,* 18.xii.1948, National Park, AD96803068 (st.); *Cleland s.n.,* 30.xii.1948, Natl. Park, AD (fl., fr.); *Cleland s.n.,* 16.ii.1952, National Park, AD96803075 (fr.); *Griffith 6,* 27.xi.1910, Myponga, NSW (fl., fr.); *Mueller 125,* Barossa, HBG, P (fl.); *Tepper s.n.,* 14.ii.1884, Ambleside, AD96811103 (fr.). *VICTORIA: Baeuerlen 55,* -.iii.1885, Genoa district, MEL (fl.); *Beauglehole 570,* -.i.1946, Gorae West, Portland, BEAUG (fl.); *Beauglehole 21827,* 16.xi.1966, McDonald Park, Ararat, BEAUG (st.); *Beauglehole 30153,* 21.xii.1968, 1.5 miles [2.5 km] ENE of Halls Gap, BEAUG (fl:); *Beauglehole 30331,* 20.i.1969, Moora Track, Grampians, BEAUG (fr.); *Beauglehole 30609,* 24.ii.1969, W. boundary of Yarram Park, Grampians, BEAUG (fl.); *Beauglehole 30699,* 22.v.1969, Brim Creek, NE of Geranium Springs, Grampians, BEAUG (st.); *Beauglehole 30833,* 24.vi.1969, W. side of Picnic Rocks — along Mockinya Creek, Grampians, BEAUG (st.); *Beauglehole, Rogers & Finck, 33367,* 7.i.1970, ± 1 mile [2 km] from Wulgulmerang-Suggan Buggan road, off Benambra road, BEAUG (fl.); *French s.n.,* 1886, Upper Murray, MEL1003736 (fl.); *Mueller s.n.,* Australia, W (fl., fr.) — syntypes (2) of *H. heterophylla* var. *capreolicornis*; *Mueller s.n.,* -.i.1885, Snowy River, MEL39128 (fl., fr.); *Mueller s.n.,* -.i.1875, Upper Loddon, MEL39061 (fl.); *Orchard 1914,* 9.ii.1969, Moora Track, Grampians, AD (st.); *Orchard 1924,* 9.ii.1969, ca 4 km north-east of Halls Gap, AD (fr.); *Orchard 1965,* 11.ii.1969, Dwyer's Creek on Halls Gap-Dunkeld road, AD (fl.); *Orchard 2636,* 5.xii.1970, Black Mountain, ca 10 km north of Wulgulmerang, AD, AK (fl.); *Reader s.n.,* 21.xii.1891, Shire of Dimboola, MEL39075 p.p. (fr.); *Reader 8,* 1892, Wimmera, MEL (fr.); *Reader 17,* 20.xii.1891, near Dimboola, MEL (fr.); *Reader 30,* Port Phillip, MEL (fl.); *Smith s.n.,* 15.vi.1918, Sunbury, MEL39252 (fl.); *Sullivan 20,* -.xi.1878, Moyston, MEL (fl.); *Williamson s.n.,* -.xii.1901, Euroa, MEL39129 (fr.); *Williamson s.n.,* -.xii.1901, & -.i.1902, Gooram, Euroa, NSW99219 (fr.); *Williamson 9,* 1893, Hopkins River, MEL (fl.); *Willis s.n.,* 18.i.1964, Yan Yean-Woodstock road, MEL39043 (fl., fr.). *TASMANIA: Curtis s.n.,* 5.iii.1945, Bridgewater, HO6679 (fr.); *Rodway s.n.,* 1891, Evandale, HO6680 (fl., fr.); *Simson 49,* Perth, HO (st.).

Although Endlicher based the species *Haloragis ceratophylla* on a Bauer specimen "in Herb. Mus. Caesar.", no collection from that herbarium, among those examined, matches the one cited. Until such a specimen is discovered, the species is based on Bauer's drawing in Endlicher's publication.

Schindler's *H. heterophylla* var. *capreolicornis* was based on at least eight different collections, and therefore required lectotypification. The lectotype, chosen to be a specimen definitely annotated by Schindler, is conspecific with *H. aspera,* but several of the syntypes (NSW9835 — "Sidney Herb. 6", NSW113152 — "Sidney Herb. 10", NSW113153 — "Sidney Herb. 11a", W (2 sheets, leg. Mueller) agree with *H. heterophylla* and are placed under that species.

The name of Black's varietas, *H. heterophylla* var. *linearis* is invalid as no Latin diagnosis was published (Eichler, 1965). The following specimens were annotated by J. M. Black with this varietal name: *J. B. Cleland s.n.,* 17.ii.1948, Rork's Drift, 9 miles [14 km] W. of Mt. Shank, S.E., AD (fl., fr.); *J. B. Cleland s.n.,* 30.xii.1948, Natl. Park, AD (fl., fr.). These specimens belong to *H. heterophylla* and do not deserve recognition on an infraspecific rank. As the name was not validly published no lectotypification is required.

The Tasmanian collections of this species are to some extent intermediate between *H. heterophylla* and *H. aspera*. The three collections cited above fall fairly clearly into *H. heterophylla*, but are linked via a ± continuous series with other plants listed under *H. aspera*.

23. **Haloragis myriocarpa** Orchard (Figs. Holotype, 147-155)

Haloragis myriocarpa Orchard, sp. nov.

Herba perennis 30-60 cm alta, folia linearia ad teretia sessilia basin versus subopposita apicem versus alterna, submucronata (2.0-) 2.5-4.5 cm longa, 0.7-1.0 (-1.5) mm lata. Flores 4-meri, in pedicellis usque ad 0.2 mm longos; sepala et petala et styli 4, stamina 8, loculi 4, uni-ovulati, ovulis pendulis. Fructus 3-7 fasciculati, ovoidei ad subpyriformos, 8-costati vel 4-angulati plus 4-costati, transverse rugosi basin versus, 0.6-0.8 mm longi, 0.5-0.7 mm lati (sepala exclusa), loculi 4, septa membranacea, pericarpium sublignosum, semina 1-4.
Typus: *B. Copley 3369*, 16.i.1971, Area of erect plants at roadside just south of 30 miles post north of Kingston S.E. To 60 cm, bright green, Damp lowlying site with Callistemon. Holotypus: AD97127110 (fl., fr.)! Isotypi: B, MEL, P, US.

Haloragis mucronata var. *trachycarpa* Black, Fl. S. Aust. (1926) 431 [Typus: "Myponga". Holotypus: *H.H.D.G.* [*Griffith*] *s.n.*, 24.i.1909, Myponga, AD (fl., fr.)!]

Haloragis mucronata auct. non (Nees) Benth.: Benth., Fl. Aust. 2 (1864) 475 p.p.; F. v. M., Census 1 (1882) 49, Sec. Census 1 (1889) 85 p.p.; F. v. M., Key Syst. Vict. Pl. 2 (1885) 22.

Haloragis digyna auct. non Labill.: F. v. M., Key Syst. Vict. Pl. 1 (1887-8) 262; F. v. M., Trans. R. Soc. Vict. 24 (1888) 137 p.p.; Ewart, Fl. Vict. (1931) 884; Willis, Hdbk. Pl. Vict. 2 (1972) 470.

FIG.: Black, Fl. S. Aust. 2 ed. (1952) fig. 875, sub. nom. *H. digyna*.

Perennial herb 30-60 cm tall, roots numerous, adventitious, rootstock small; stems erect, numerous, subwoody, ± smooth or weakly 4-ribbed, branching mainly from base, glabrous (Figs. 148, 149).

Leaves sessile, opposite or subopposite at base, becoming alternate above, linear to terete, (2.0-) 2.5-4.5 cm long, 0.7-1.0 (-1.5) mm wide, submucronate, ± channelled below, margins entire or very weakly tubercular toothed, ribs not apparent, glabrous or very sparsely scabrous on margins with short, thick, curved, 1-2-celled translucent hairs up to 0.1 mm long (Figs. 150, 151).

Inflorescence an indeterminate spike of 5-7-flowered dichasia in the axils of alternate primary bracts. Lateral inflorescences are borne in the axils of the upper 4-10 leaves. Primary bracts leaf-like, green, fleshy, linear-lanceolate, 4.5-6.0 mm long, 0.5-1.7 mm wide, mucronate, glabrous or scabrous as for leaves; secondary bracts membranous, brown, lanceolate, 0.5-0.8 mm long, 0.3 mm wide; tertiary bracts as for secondary bracts, 0.3-0.4 mm long, 0.1-0.2 mm wide; quaternary bracts etc. up to 0.3 mm long (Figs. 152, 153).

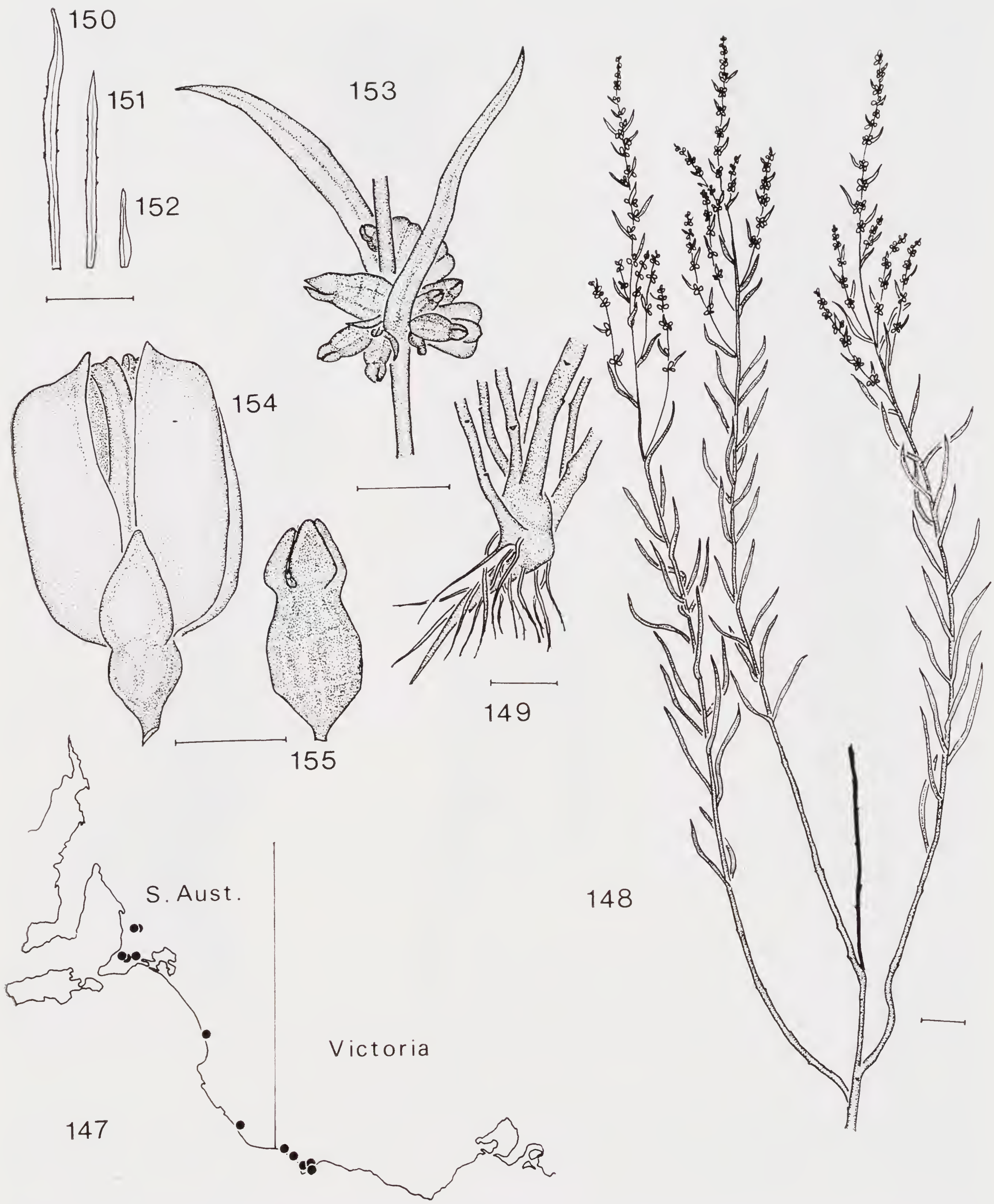
Flowers 4-merous, ± sessile or on pedicels up to 0.2 mm long, protandrous. Sepals 4, green to red, narrow deltoid, 0.6-0.9 mm long, 0.4-0.8 mm wide, smooth or midribbed. Petals 4, red, hooded, tip erect, unguiculate, (2.0-) 2.2-2.7 mm long, 0.6 mm wide (keel to margin). Stamens 8, filaments 0.1 mm long; anthers oblong, 1.3-1.5 mm long, 0.4-0.5 mm wide, red to yellow, 4-celled, nonapiculate. Styles 4, clavate, 0.3 mm long, stigmas capitate. Ovary ovoid to hemispherical, 0.3-0.5 mm long, 0.5-0.6 mm wide, 4-angled opposite the petals, 4-ribbed opposite the sepals, 4-locular with 1 ovule per locule (Fig. 154).

Fruits 3-7 per axil, ± sessile or on pedicels 0.2-0.5 mm long, green to red-purple, ovoid to sub-pyriform, 1.2-1.5 mm long, 1.0-1.4 mm wide, 8-ribbed, or 4-angled plus 4-ribbed, weakly transversely rugose in lower part, glabrous; sepals persistent, erect, deltoid, 0.6-0.8 mm long, 0.5-0.7 mm wide, lacking midrib; 4-locular, septa membranous, pericarp subwoody, 1-4 seeds (Fig. 155).

DISTRIBUTION: *H. myriocarpa* is confined to south-eastern South Australia and south-western Victoria, in a coastal strip from Adelaide to about Portland (Fig. 147).

ECOLOGY: This species has been found only in swampy areas, either in heath-type vegetation, or associated with shrubs such as *Melaleuca*. Collectors' notes include "damp lowlying site with *Callistemon*" (*Copley 3369*); "heath-land swamp, associated with *Prasophyllum hartii*" (*Beauglehole 352*); "river under dense bushes, rare" (*Tepper 519*); and "growing on grey to black soil; made appearance when paddock unstocked" (*Secker s.n.*). Flowering has been recorded from December to February, and fruiting from December until April.

Holotype of *Haloragis myriocarpa.*



Figs. 147-155. *Haloragis myriocarpa*. 147. Distribution. 148. Habit. 149. Rootstock. 150, 151. Leaves. 152. Primary bract. 153. Portion of inflorescence. 154. Flower. 155. Fruit. (figs. 148-155 all from *Copley 3369*). Scales represent 1 cm (figs. 148-152) or 1 mm (figs. 153-155).

SPECIMENS EXAMINED:

SOUTH AUSTRALIA: Anon s.n., 15.iv.1927, Myponga, AD (fr.); *Cleland s.n.,* 20.i.1951, Lower Black Swamp ca 25 km N.N.E. of Victor Harbour, AD96803074 (fr.); *Copley 3369,* 16.i.1971, just south of 30 miles post, [48 km] north of Kingston, AD (fl., fr.) — holotype of *H. myriocarpa*; *H.H.D.G.* [*Griffith*] *s.n.,* 24.i.1909, Myponga, AD (fl., fr.) — holotype of *H. mucronata* var. *trachycarpa*; *Mueller s.n.,* Onkaparinga, MEL38944 p.p. (fl.); *Mueller s.n.,* Murray scrub, MEL38944 p.p. (fr.); *Mueller s.n.,* -.i.1852, ad flumen Onkaparinga, MEL38945 (fr.); *Mueller s.n.,* Murray desert, MEL38946 (fl.); *Mueller s.n.,* 1876 Lake Bonney, MEL38951, 38952 (fr.); *Secker s.n.,* 2.i.1941, Reedy Creek, ADW4377 (fl.); *Tepper 519,* 21.i.1882, -.ii.1883, Clarendon, AD, MEL (fl.). *VICTORIA: Allitt s.n.,* Portland, MEL38943 (fl., fr.); *Beauglehole s.n.,* -.ii.1947, "Jennings" near Surrey River, Gorae, MEL38942 (fr.); *Beauglehole 352,* -.xii.1947, Gorae West, BEAUG (fl., fr.); *Beauglehole 17017,* 9.xii.1950, Gorae West, Portland, BEAUG (fl.); *Beauglehole 17026,* 2.i.1960, ± 7 miles [11 km] E. of Glenelg River mouth, Long Swamp, BEAUG (fl.); *Beauglehole 33405,* 12.ii.1970, Kentbruck Heath, 6 miles [10 km] direct N.N.W. of Mt. Kincaid, BEAUG (fl., fr.).

The type sheet of *H. mucronata* var. *trachycarpa* in AD consists of two separate collections from Myponga. Only the one cited as holotype above can be considered type material, as the other (*Anon s.n.*) was collected after publication of the name.

The collection of Secker differs from all others in being completely glabrous.

Several writers have reported the occurrence of "*H. digyna*" or "*H. mucronata*" in New South Wales (e.g. Moore (1893), Dixon (1906), Maiden & Betche (1916).) As collections of genuine *H. digyna* are only known from as far east as Eyre Peninsula, it is likely that the species involved is *H. myriocarpa*, or an entire-leafed form of *H. heterophylla*, if indeed any such plant exists. No collections have been seen to support this record, which apparently dates from Mueller (1882).

The epithet "*myriocarpa*" reflects the appearance of the fruiting spike where clusters of 3-7 fruits are closely associated.

In general appearance *H. myriocarpa* closely resembles *H. digyna* but differs in its strictly 4-merous flowers and fruits. It is most closely related to *H. heterophylla*, from which it is distinguished by its terete leaves, short curved hairs and less ornamented fruit.

24. **Haloragis digyna** Labill. (Figs. 156-158)

Haloragis digyna Labillardiere, Nov. Holl. Pl. Sp. 1 (1805) 101, t. 129 [Typus: "Habitat in terra Van Leuwin." Holotypus: *Labillardiere s.n.,* Novae Hollandiae ora austro occidentalis, FI (herb. Webb ex herb. Labill.) (fl.) photo.! Isotypi: *Labillardiere s.n.,* N. Holl., FI (herb. Webb ex herb. Desf.) (fl.) photo.!; *Labillardiere s.n.,* Nouv. Holl. Sud-ouest, G (herb. Deless., Vent.) (fl., fr.)!] Drake (?), in Rees, Cyclop, 16 (1811); Sprengel (ed.), Syst. Veg. 2 (1825) 261; DC., Prod. 3 (1828) 67; Nees in Lehm., Pl. Preiss. 2 (1848) 226; Sonder, Linnaea 28 (1856) 231; Montr., Mem. Acad. Lyon 10 (1860) 199; Benth., Fl. Aust. 2 (1864) 475; F. v. M., Census 1 (1882) 49; Tate, Trans. R. Soc. S. Aust. 7 (1884) 72; F. v. M., Trans. R. Soc. Vict. 24 (1888) 137 p.p.; F. v. M., Sec. Census 1 (1889) 85; Tate, Trans. R. Soc. S. Aust. 12 (1889) 95; Tate, Fl. S. Aust. (1890) 101, 234 p.p.; Petersen, Pflfam. III. 7 (1893) 232; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 24; Schindler, Pflrch 23 (1905) 12, 52; Gardner, Enum. (1931) 99; Black, Fl. S. Aust. 2 ed. (1952) 643 p.p.; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 468; Praglowski, Grana 10 (1970) 178.

Gonocarpus mucronatus Nees in Lehm, Pl. Preiss. 2 (1848) 225 ('*Goniocarpus*') [Typus: "In solo sublimoso silvae ad fluvium Vasse-river (Sussex). Decembri a. 1839. Herb. Preiss 1221." Holotypus: n.v. Isotypi: *Preiss 1221,* 1843, Nova Holland. occid., LE (fl.)!; *Preiss 1221,* Vasse River (Sussex) Nov. Holl. occid., MEL38949 (fl., fr.)!; *Preiss 1221,* MEL38948 (fr.)!; *Preiss 1221,* 1843, Swan River [Colony], G (herb. DC.)!, P! (fl., fr.)]

Haloragis mucronata (Nees) Benth., Fl. Aust. 2 (1864) 475 p.p.; Schomburgk, Fl. S. Aust. (1875) 40 p.p.; Tate, Trans. R. Soc. S. Aust. 3 (1880) 64, 6 (1883) 156; F. v. M., Census 1 (1882) 49, Sec. Census 1 (1889) 85 p.p.; Black, Fl. S. Aust. (1926) 430 p.p.

FIGS.: Schindler, Pflrch 23 (1905) fig. 15e; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 468.

Perennial herb, 20-40 cm tall, perennating and spreading from a deep lateral rootstock, stems erect or ascending, profusely branched, smooth, green or reddish, glabrous or sparsely scabrous with semi-appressed, 1-2 celled simple hyaline hairs 0.1-0.2 mm long (Fig. 157).

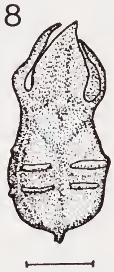
Leaves opposite or subopposite at base, alternate above, linear, (1.0-) 1.5-2.0 (-2.3) cm long, (1.0-) 1.5-2.0 mm wide, sessile, flattened, midrib and veins obscure, entire or weakly serrate with 1-4 teeth, submucronate, scabrous on margins with hairs as for stems.

Inflorescence an indeterminate spike of 3-7-flowered dichasia in the axils of alternate primary bracts. Lateral inflorescences arise in the axils of the upper 2-6 leaves. Primary bracts leaflike, green, fleshy, linear, 5.0-9.0 mm long, 1.0-1.5 mm wide, entire, scabrous on margin; secondary bracts brown, membranous, linear, 1.0-1.2 mm long, 0.1-0.2 mm wide, scabrous; tertiary bracts brown, membranous, linear-lanceolate, 0.6 mm long, 0.1-0.2 mm wide, scabrous.

157

156

158



Figs. 156-158. *Haloragis digyna.* 156. Distribution. 157. Habit (from *Orchard 2993*). 158. Fruit (from *Preiss 1221*). Scale represents 1 cm (fig. 157) or 1 mm (fig. 158).

Flowers 2-3 (-4)-merous, all functional except on some ultimate branches, on pedicels 0.4-0.5 mm long. Sepals 2-3 (-4), green, deltoid, 0.6-0.7 mm long, 0.4-0.6 mm wide, lacking midribs, scabrous. Petals 2-3 (-4), red, hooded, tip horizontal or erect, unguiculate, 2.2-2.3 mm long, 0.7 mm wide (keel to margin), scabrous on keel. Stamens 4-6 (-8), filaments 0.2 mm long; anthers yellow, oblong, 1.7-1.9 mm long, 0.2-0.3 mm wide, 4-locular, nonapiculate, antisepalous anthers ca 0.1-0.2 mm longer than antipetalous ones. Styles (1-) 2-3, clavate, 0.5 mm long, stigmas capitate. Ovary ovoid or trigonous, 0.7-0.8 mm long, 0.5-0.6 mm wide, 3-4-ribbed or -angled, otherwise smooth, scabrous, locules same number as styles, 1 ovule per locule.

Fruits 1-3 per axil, ovoid-trigonous, 1.3-1.5 mm long, 0.9-1.0 (-1.4) mm wide, weakly ribbed opposite sepals and petals, verrucose in lower part or smooth, scabrous; sepals persistent, erect, deltoid, 0.6-0.7 (-1.0) mm long, 0.5-0.7 (1.0) mm wide, lacking midrib; fruit 1-3 locular, pericarp and septa ± woody, 1 seed per locule (Fig. 158).

Distribution: Scattered collections are known from near Busselton in south-western Western Australia, to near Cummins on southern Eyre Peninsula in South Australia (Fig. 156).

Ecology: Little is known of the soil and habitat preferences of this species. A Copley collection (2459) had the annotation "a few plants at roadside" while *Copley 2978* grew as "a clump in grass at road corner". *Orchard 2993* (probably from the same population as *Copley 2978*) was growing in heavy red clay-loam amongst introduced grasses on a cleared roadside bank. Flowering occurs from November until December, and fruiting from December until January.

Specimens examined:

WESTERN AUSTRALIA: Bate s.n., 1886, Eucla, MEL38955 (fr.); *Brooke s.n.,* 1885, Israelite Bay, MEL38954 (fr.); *Labillardiere s.n.,* Nouv. Holl. Sud-ouest, G (herb. Deless., Vent.) (fl., fr.) — isotype of *H. digyna; Maxwell s.n.,* S.W. Austr., MEL38953 (fl., fr.); *Oliver (?) s.n.,* Eucla, MEL1003694 (fr.); *Preiss 1221,* Nova

Holland. occid., Vasse River, G, LE, MEL, P (fl., fr. — types of *G. mucronatus*. *SOUTH AUSTRALIA: Alcock 2553,* 12.xi.1968, road between Sections 13 & 16, Hundred of Cummins, AD, ADW (fl.); *Copley 2459,* 25.i.1969, 4 miles [6 km] west of Butler Tanks, AD (fr.); *Copley 2978,* 1.i.1970, 16 miles [26 km] east of Yeelanna, AD (fr.); *Orchard 2993,* 30.xii.1970, ca 13 km west of Ungarra on road to Yeelanna, AD (fl., fr.).

The fruits in the collections of Brooke and Oliver (and perhaps those of Labillardiere, although they are very immature) have swollen pericarps, differing in this respect from all other specimens. The hairs on Oliver's collection are slightly hooked at the tip, approaching the condition of those of *H. hamata.*

Several authors, including Bentham and Mueller, have recorded *H. digyna* (as '*H. mucronata*') from Victoria, New South Wales and south-eastern South Australia. The records from New South Wales apparently originate from Mueller (1882), but do not seem to be supported by specimens. The records of the species in Victoria and south-eastern South Australia date from Bentham (1864). Of the collections cited by Bentham, those from Victoria, and Mueller's collections from South Australia belong in *H. myriocarpa,* while Brown's collection from Kangaroo Island is flowering material of *H. acutangula.*

25. **Haloragis tenuifolia** Benth. (Figs. 159-162)

Haloragis tenuifolia Bentham, Fl. Aust. 2 (1864) 477 [Typus: "W. Australia, Drummond, 4th Coll. n. 86". Holotypus n.v. Isotypi: *J. Drummond IV, 86,* Australia, ad. fl. Cygnorum, LE (fl., fr.)!; *J. Dr. 86,* W.A., MEL 39299 (fl., fr.); *Drummond 4th Collection No. 86,* 1848, W. Australia, NSW99269 ex BM (fl., fr.); *J. Drummond 4th ser. No. 86,* Swan R., W (fl., fr.)! *Drummond 86,* 1848, Swan River, G (herb. Boiss., Deless.)!, P! (fl., fr.);] Benth., Fl. Aust. 2 (1864) 477 (sub. *H. aculeolata*); F. v. M., Census 1 (1882) 49, Sec. Census 1 (1889) 85; F. v. M., Trans. R. Soc. Vict. 24 (1888) 137 ('*H. tennifolia*'); Petersen, Pflfam. III 7(1893) 232; Schindler, Bot. Jb. 34 Beibl. 77 (1904) 5, 30; Diels & Pritzel, Bot. Jb. 35 (1904) 447 Schindler, Pflrch 23 (1905) 54; Britten, J. Bot. 45 (1907) 136; Ostenfeld, K. danske Vidensk. Selsk., Biol. Medd. 3 (1921) 99; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 471; Praglowski, Grana 10 (1970) 180.

Figs: Blackall & Grieve, W. Aust. Wildfls 3 (1965) 471; Praglowski, Grana 10 (1970) pl. 7 (d-f).

Annual herb 23-30 (-50) cm tall, glabrous, stems erect, herbaceous, ± unbranched, smooth or very weakly 4-ribbed, rooting at the lower nodes (Fig. 160).

Leaves alternate, sessile, pinnatifid, segments 0.5-2.0 cm long, 0.1-0.15 cm wide, midrib obscure above, weakly prominent below, lamina (1.5-) 3.0-5.0 cm long, 0.5-2.0 cm wide (including segments).

Inflorescence an indeterminate spike of 1-3 (-5)-flowered dichasia in the axils of primary bracts. Lateral inflorescences absent. Primary bracts leaflike, pinnatifid or linear, 0.5-3.0 cm long, rapidly reduced in length and dissection towards apex, segments 0.5-0.7 mm wide; secondary bracts brown, membranous, linear, 0.7-0.8 mm long, 0.1-0.2 mm wide; tertiary bracts brown, membranous, linear, 0.5-0.6 mm long, 0.1 mm wide (Fig. 161).

Flowers 3-merous (rarely occasional flowers 2-merous), on pedicel 0.2-0.5 mm long. Sepals 3, broadly ovate, 0.5-0.6 mm long, 0.6-0.7 mm wide, not ribbed. Petals 3, hooded, tip rounded, keeled, unguiculate, 2.7-3.0 mm long, 0.7-0.9 mm wide (keel to margin). Stamens 6, filaments 0.2-0.3 mm long; anthers yellow, oblong, 2.5-2.6 mm long, 0.3-0.4 mm wide, nonapiculate, 4-celled, antipetalous anthers 0.1-0.2 mm shorter than antisepalous ones. Styles 3, clavate, 0.4-0.5 mm long, stigmas capitate. Ovary ovoid, 0.5-0.7 mm long, 0.4-0.7 mm wide, longitudinally 3-lobed opposite petals, 3-channelled opposite sepals.

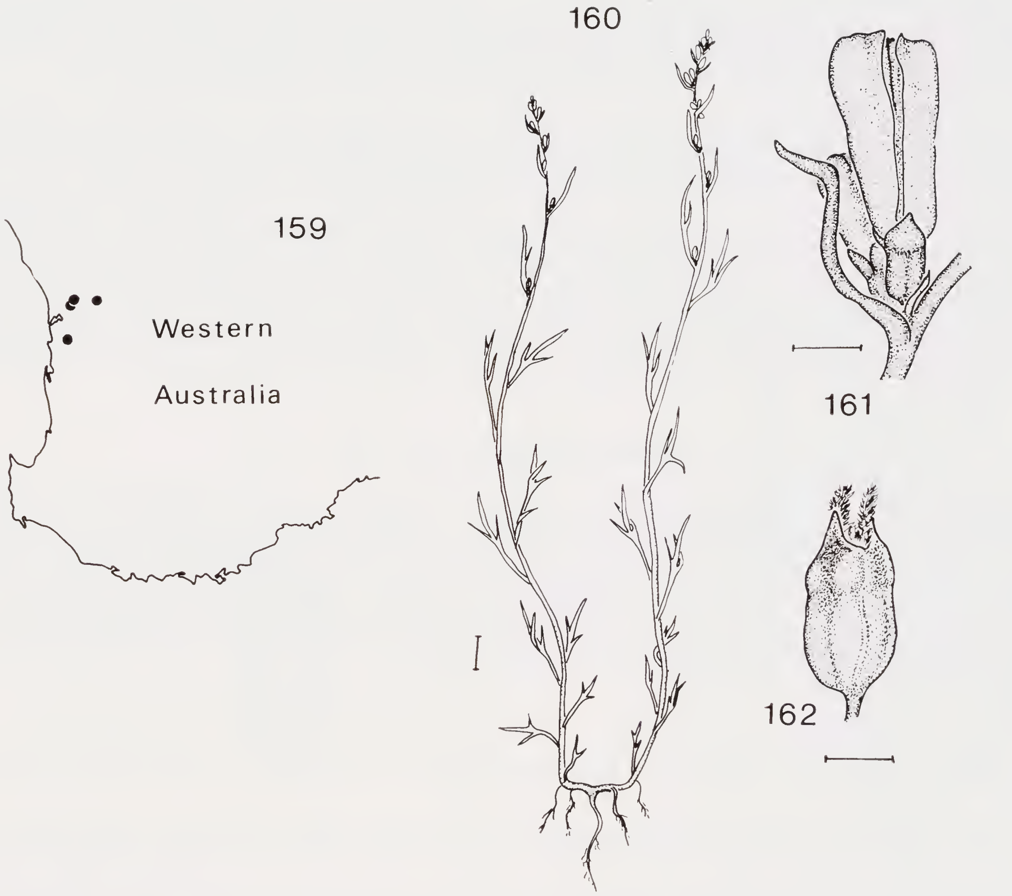
Fruits 1-3 (-5) per axil, on pedicel 0.7 mm long, ovoid, 1.7-2.4 mm long, 0.9-1.6 mm wide, trigonous, smooth or slightly rugose, lobes between sepals rounded; sepals persistent, erect, deltoid, (0.4-) 0.5-0.9 mm long, (0.5-) 0.6-0.9 mm wide; fruit 3-locular, pericarp and septa ± woody, 1-3 seeds (Fig. 162).

Distribution: *H. tenuifolia* is confined to the Darling Ranges-Swan River area near Perth, Western Australia (Fig. 159).

Ecology: From the general appearance of the plant, and the sparse collectors' notes, it seems likely that *H. tenuifolia* grows in damp or swampy places, probably in grassy or sedge dominated habitats. Collectors' notes include "in moist places" (*Koch 1792*) and "in inundatis exsiccatis arenoso-lutosis" (*Diels 1811*). Flowering and fruiting specimens have been collected in November and December.

Specimens examined:

WESTERN AUSTRALIA: Anderson s.n., 19.xii.1930, Midland Junction, PERTH (fl., fr.); *Diels 1811,* Byfield's Mill, NSW (fl., fr.); *Drummond IV, 86,* 1848, Swan River, G, LE, MEL, NSW, P, W (fl., fr.) — types of *H. tenuifolia*; *Koch 1792,* -.xi.1907, Wooroloo, AD, MEL, NSW (2 sheets) (fl., fr.); *Koch 1675 p.p.,* -.xi.1906, Darling Range, NSW (fl., fr.).



Figs. 159-162. *Haloragis tenuifolia.* 159. Distribution. 160. Habit. 161. Portion of inflorescence showing two flowers and primary bract. 162. Fruit. (figs. 160-162 from *Drummond 86*). Scale represents 1 cm (fig. 160) or 1 mm (figs. 161, 162).

No specimen among those examined from K or MEL could reasonably be considered to be the holotype of this species, as they all lacked the indication of being from Drummond's 4th collection. Specimens from LE, NSW (ex BM) and W all bore this information, and are undoubtedly isotypes. The holotype may be in BM, but collections from this herbarium were not available during the present study.

H. tenuifolia very closely resembles *H. brownii*, differing mainly in its trimerous flowers and fruits and (usually) more slender foliage.

26. **Haloragis brownii** (Hook. f.) Schindl. (Fig. 163)

Haloragis brownii (Hook f.) Schindler, Bot. Jb. 34 Beibl. 77 (1904) 5, 6, 25, 30, 31, et Pflrch 23 (1905) 54; Maiden & Betche, Census N.S. Wales Pl. (1916) 158; Black, Fl. S. Aust. (1926) 431, 2 ed. (1952) 643; Ewart, Fl. Vict. (1931) 883; Gardner, Enum. (1931) 99; Curtis, Stud. Fl. Tas. 1 (1956) 189; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 472; Praglowski, Grana 10 (1970) 180; Willis, Hdbk. Pl. Vict. 2 (1972) 469; Aston, Aqu. Pl. Aust. (1973) 77.

Meionectes brownii Hook. f. in Hook., Ic. Pl. 4 (1841) t. 306. [Typus: "Van Dieman's Land, near Circular Head, in wet places, Mr R. Gunn, (n. 883)" Holotypus: *Mr Gunn 883,* 1837, Van Ds. Land, K (herb. Hook.) (fl., fr.)!] Walp., Rep. 2 (1843) 98 ['*Meionectis brownei*']; Walp., Rep. 5 (1846) 671 ['*Meionectis*']; Nees in Lehm., Pl. Preiss. 2 (1848) 225 [*Mejonectes Brownii*']; Hook. f., Fl. Tas. 1 (1856) 123; Benth., Fl. Aust. 2 (1864) 486; Tate, Trans. R. Soc. S. Aust. 3 (1880) 63; Baillon, Nat. Hist. Pl. 6 (1880) 479; F. v. M., Census 1 (1882) 50; F. v. M., Key Syst. Vict. Pl. 2 (1885) 22; Moore, Hdbk. Fl. N.S. Wales (1893) 186; Petersen, Pflfam. III. 7 (1893) 233; Rodway, Tas. Fl. (1903) 49; Dixon, Pl. N.S. Wales (1906) 130.

Meionectes preissii Nees in Lehm., Pl. Preiss 2 (1848) 224-225 [Typus: "In arenosis ad marginem lacus Mongers-lake (Perth) d. 9 Febr. a. 1839. Herb. Preiss. No. 2385." Holotypus: n.v. Isotypi: *L. Preiss, 2385,* 9.ii.1839, In arenosis ad marginem lacus "Mongers lake" (Perth), LE fl., fr.)!; *Preiss 2385,* 9.ii.1839, In arenosis ad marginem lacus "Mongerslake" (Perth), MEL1003464 (fl.)!; *Preiss 2385,* 1843, Swan River, G (herb. DC.) (fl., fr.)!]

Haloragis meionectes [F. v. M., Trans. R. Soc. Vict. 24 (1888) 137, comb. implied but not made] F. v. M., Key Syst. Vict. Pl. 1 (1888) 261 (nom. illeg.; '*Meionectes Brownii*' is quoted as a synonym); Tate, Trans. R. Soc. S. Aust. 12 (1889) 95; F. v. M., Sec. Census 1 (1889) 86 Tate, Fl. S. Aust. (1890) 101, 234; Diels & Pritzel, Bot. Jb. (1904) 446.

Haloragis breviloba Schindler, Bot. Jb. 34 Beibl. 77 (1904) 5, 30, et Pflrch 23 (1905) 56 [Typus: "West Australien: Swan River (Diels n. 5494) — Herb. Berlin." Holotypus: B, n.v. (destroyed). Isotypi: *Diels 5494,* West Australia, NSW113148 ex B (fl.)!; *L. Diels 5494,* 12.xi.1801, West Australien: Swan River. Guildford, MEL38934 (fl.)!]; Britten, J. Bot. 45 (1907) 136; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 472.

Figs.: Hook., Ic. Pl. 4 (1841) pl. 306; Schindler, Pflrch 23 (1905) fig. 16 (A-D); Black, Fl. S. Aust. 2 ed. (1952) fig. 876; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 472; Praglowski, Grana 10 (1970) pl. 7 (g-k); Aston, Aqu. Pl. Aust. (1973) fig. 28.

Herbaceous aquatic or semiaquatic plants, annual or perennial, growing either on damp shaded soil near water, when the stems are decumbent and ± supported by surrounding vegetation, or else in stagnant or slowly flowing fresh water up to 60 cm deep, when only the tips of the stems bearing flowers and fruits are emergent. Stems 10-40 cm long on land, up to 1 m or more in water, rooting at nodes, not or faintly longitudinally ribbed, glabrous.

Leaves alternate, ovate, pinnatipartite, 2.0-4.0 (-5.5) cm long, 2.0-3.5 (-4.0) cm wide, glabrous, midrib obscure; the lobes also pinnatipartite (at least in lower leaves), 1.5-2.0 mm wide in emergent leaves, less than 1 mm wide in submerged leaves, mid-vein present in all but the smallest lobes.

Inflorescence an indeterminate spike of 3-11-flowered dichasia borne in the axils of alternate primary bracts. Lateral inflorescences sometimes arise in axils of 2-4 upper leaves. Primary bracts leaflike, trifid to pinnatifid, grading into upper leaves in size and shape, gradually reduced towards apex, glabrous; secondary bracts linear, 0.4-0.6 mm long, 0.1-0.15 mm wide, brown, membranous; tertiary bracts linear-deltoid, minute, brown, membranous.

Flowers bimerous, glabrous, on pedicels 0.4-0.5 mm long. Sepals 2, deltoid, 0.8-1.0 mm long, 0.9-1.0 mm wide, lacking midrib. Petals 2, hooded, non-unguiculate, 1.7-2.5 (-2.9) mm long, 0.3-0.5 mm wide (keel to margin), yellow-green to reddish. Stamens 4, filaments (0.3-) 0.6-0.8 (-1.2) mm long; anthers narrow-oblong, 1.0-2.0 (-3.0) mm long, 0.4-0.5 mm wide, 4-celled, nonapiculate. Styles 2, 1 mm long, stigmas shortly fimbriate. Ovary ovoid, ± compressed in plane of petals, 1.1-1.3 mm long, 0.8-1.0 mm wide, slightly furrowed from base of sepals, 2-locular with 1 pendulous ovule per locule.

Fruits 1-5 per axil, compressed-ovate, 2.8-3.1 mm long, 2.2-2.7 mm wide, margins muricate, undulate, sometimes ± winged. Persistent sepals ovate with prominent midvein. Exocarp very slightly spongy, endocarp and septum woody; 2 locules with a single seed in each.

Fig. 163. Distribution of *Haloragis brownii*.

DISTRIBUTION: *H. brownii* is known from south-western Western Australia, south-eastern South Australia (including Kangaroo Island) and from Victoria and Tasmania. It has also been stated to occur in New South Wales (Schindler, 1905), but no specimens have been seen which support this statement (Fig. 163).

ECOLOGY: This species is usually found in or near ± stagnant fresh water. Collectors' notes include "on edge & in water of a swamp assoc. with Tuart & *Mel. rapheophylla*" (*Smith UWA490*); "with *Potamogeton* in *Typha* swamp. Water 14" deep (*Marchant 114*); "common on damp mud beside a small fresh-water swamp, in shaded situation" (*Aston 1442*); "in 30-45 cm water" (*Orchard 1999*) and "on mud above water level. Semi-erect plants amongst small reeds and grasses, etc., and partially supported by them" (*Orchard 2000*). Flowers are borne usually from October until February and fruits from October until May.

SPECIMENS EXAMINED:

WESTERN AUSTRALIA: Anon s.n., between Perth and York, MEL1003450 (fl.); *Anon. s.n.,* Herdsman's Lake near Perth, UWA491 (fl., fr.); *Allmon s.n.,* -.iii.1916, Osborne Park, PERTH (fr.); *Andrews 45,* 17.x.1901, Guildford, PERTH (fl.); *Brown s.n.,* K.G. Sound, MEL1003460 (fl., fr.); *Churchill s.n.,* 25.xii.1957, Cape Leeuwin, UWA492 (fl.); *Churchill s.n.,* Mid Beach Swamp, UWA493 (fl.); *Diels 5494,* 12.xi.1801, Guildford, MEL, NSW (fl.) — isotypes of *H. breviloba*; *Fitzgerald s.n.,* -.v.1901, Leederville, NSW99280 (fl., fr.); *George s.n.,* 5.ii.1965, Cullelal Lake, Wanneroo, PERTH (fl., fr.); *Helms s.n.,* -.xii.1896, Albany, NSW103121 (fl.); *Helms s.n.,* -.xii.1898, Albany, PERTH (st); *Jones s.n.,* -.xi.1963, Maddington, PERTH (fl.) — pollen sent to Palyn. Lab. Stockholm; *Knight s.n.,* -.x.1959, White Lakes, UWA489 (st.); *Koch 2544,* 21.i.1921, Big Brook, Pemberton, BRI, MEL (fl., fr.); *Marchant 114,* 23.xii.1957, Safety Bay, PERTH (fr.); *McComb 215,* -.ix.1966, Lock McNess, Yanchep, UWA (st.); *Morrison s.n.,* 29.xi.1899, Cannington, BRI079977 (fl.); *Morrison s.n.,* 19.i.1901, Herdsman's Lake, CANB136619, PERTH (fl., fr.); *Morrison s.n.,* 8.ii.1902, l.c., AD96344261, BRI079979, 087251, CANB136618, PERTH (fr.); *Morrison s.n.,* Subiaco, PERTH (fl.); *Morrison s.n.,* 6.iii.1909, Herdsman's Lake, CANB136620, PERTH (fr.); *Mueller s.n.,* -.xi.1877, upper Swan River, MEL1003451, 1003462 (fl.); *Mueller s.n.,* 10.xii.1877, upper Blackwood River, MEL1003461 (fl.); *Preiss 2385,* 9.ii.1839, Monger's Lake, LE, MEL (fl., fr.) — isotypes of *Meionectes preissii*; *Preiss 2385,* 1843, Swan River, G (fl., fr.) — ? isotype of *M. preissii; Preiss s.n.,* Busselton, MEL1003459 (fr.); *Royce 3167,* 15.x.1949, Ambergate, S. of Busselton, PERTH (fl.); *Royce 5834,* 24.ii.1959, Jandakot, PERTH (fl., fr.); *Smith s.n.,* -.x.1959, Safety Bay, UWA490 (st.); *Smith s.n.,* -.viii.1966, Augusta, UWA529 (st.); *Walcott s.n.,* Karri Dale, MEL1003465 (fl., fr.). *SOUTH AUSTRALIA: Cleland s.n.,* Morialta, AD968061225 (st.); *Cleland s.n.,* 29.i.1924, upper Hindmarsh River, AD966032563, 968020528 (fl., fr.); *Cleland s.n.,* 18.ii.1924, Rocky River, K.I., AD968020545 (fl., fr.); *Cleland s.n.,* 5.iii.1926, Squashy Creek, K.I., AD968020542 (st.); *Cleland s.n.,* 17.i.1931, Back Valley, AD968020548 (fl., fr.); *Cleland s.n.,* 20.xii.1942, upper Waterfall Gully, AD968020532 (fr.); *Cleland s.n.,* ca 10 km south-east of Cape Banks, AD968020529 (fr.); *Eardley s.n.,* 8.ii.1942, 8-mile Creek swamp, ADW4958 (fr.); *Ising s.n.,* 29.vi.1929, Morialta, AD966032039 (st.); *Mueller s.n.,* Dec. 29, Mt. Lofty Range, MEL1003452, 1003454, 1003455 (fr.); *Tate s.n.,* 16.xi.1882, Cape Northumberland lagoon, AD96810063 (fl., fr.); *Tepper 1145,* 24.xi.1885, Belair National Park, AD (fr.); *Tepper 1195, 1196,* -.ii.1884, Belair National Park, AD (fl., fr.); *Tepper 1619,* 25.vi.1885, Patawalonga, AD (fr.); *C.W. s.n.,* entrance of River Murray, MEL1003456 (st.).. *VICTORIA: Audas s.n.,* -.xii.1912, near Vereker Range, Wilson's Promontory, MEL1003449 (fr.); *Audas & St. John s.n.,* 14.xi.1908, Oberon Bay Swamp, MEL1003440 (fl., fr.); *Aston 1442,* 14.xii.1965, ½ mile [1 km] S.W. of Drik Drik, AD (fl., fr.); *Beauglehole 5861,* 13.xi.1963, 2½ miles [4 km] S.W. of Portland post office, MEL (fl., fr.); *Beauglehole 7086,* -.xii.1965, Long Swamp, ± 2 miles [3 km] E. of Glenelg [River] mouth, MEL (fl., fr.); *Beauglehole & Finck 21342,* 9.ix.1966, Two Mile Bay, Port Campbell National Park, BEAUG (st.); *Meebold 2463,* -.i.1929, Wilsons Promontory, M (fr.); *Mueller s.n.,* Wilson's Promontory, MEL1003438, 1003453, NSW99284 (fr.); *Mueller s.n.,* Port Phillip, MEL1003448 (fr.); *Mueller s.n.,* 30.iv.1853, entrance to the Snowy River, MEL1003447 (fr.); *Mueller s.n.,* 11.v.1853, Wilson's Promontory, MEL1003441, 1003445 (fr.); *Mueller s.n.,* -.ii.1855, mouth of the Snowy River, MEL1003442, NSW99282 (fr.); *Orchard 1999, 2000,* 11.ii.1969, Bridgewater Lakes ca 35 km west of Portland, AD, CHR (fl, fr.); *Orchard 2018,* 13.ii.1969, Long Swamp, AD, AK (fl., fr.); *Walters s.n.,* -.xi.1897, Grampians, NSW99281 (l.); *Williamson s.n.,* -.i.1896, Winslow, NSW99283 (fl.); *Williamson s.n.,* -.x.1897, Winslow, MEL1003443 (fl., f.); *Williamson s.n.,* -.xii.1902, Hawkesdale, BRI079976 (fl., fr.). *TASMANIA: Gunn 883,* 1837, Van Ds. Land, K (fl., fr.) — holotype of *Meionectes brownii*; *Hooker s.n.,* Tasmania, UPS (fr.); *Rodway s.n.,* -.xii.1911, Trial Harbour, HO6702 (fl.); *Williamson 1712,* -.xi.1912, Flinders Is., MEL1003466 (fl.).

The Preiss collection in herb. G is tentatively listed as an isotype of *Meionectes preissii* on the basis of the collector's number. The locality given ("Swan River") is a general designation including the type locality ("Monger's Lake"), but the date (1843) does not agree with that on the other type collections (9.ii.1839). It is probable that this later date represents the date of accession (by herb. G) rather than the date of collection.

H. brownii is most closely related to *H. tenuifolia,* which it resembles in habit, leaf shape and habitat preference. It differs mainly in its bimerous flowers and fruits; those of *H. tenuifolia* are trimerous.

GENUS **HALORAGODENDRON**

Haloragodendron Orchard, gen. nov.

Haloragis p.p., auct. pl., non Forster (1775).

Halorrhagis sect. Pleianthus subsect. Spongiocarpus Schindler, Pflrch 23 (1905) 59, p.p. (excl. *H. stricta, H. paniculata, H. lanceolata).*

Frutices vel arbores parvae, glabrae, 1-3 m. altae; caules erecti, valde 4-angulati; folia decussata, serrata vel biserrata, petiolata vel subsessilia. Inflorescentia terminales, racemosa, flore apicali et dichasiis compositis in axillis foliorum superorum reductorum pauxillum dispositis. Flores bisexuales, tetrameri; petala navicularia vel planiuscula, non cucullata, eburnea vel sanguinea, 2.5-5.5 mm longa; antherae lineares vel apices versus decresentes, bases versus rotundatae vel sagittatae aliquam, connectiva in apicula plus minusve curvata producta. Ovarium quadri-alata vel quadri-costata, ovula quattuor pendula, locula quattuor completa vel incompleta septis solidis non nisi in apice lateribus basique praesentibus. Fructus indehiscens, 1-seminalus, 4-alatus vel 4-costatus, pericarpium plus minusve spongiosum, endocarpium lignosum pauxillum.

Type species: *Haloragodendron racemosum* (Labill.) Orchard, comb. nov. (Basionym: *Haloragis racemosa* Labill. Nov. Holl. Pl. Sp. 1 (1805) 100, pl. 128).

Glabrous shrubs or small trees 1-3 m tall, branches spreading or erect, decussately arranged, ± square with 4 prominent vertical ribs, smooth or dotted with raised tubercular oil glands, often reddish; leaves decussate, petiolate or almost sessile, juvenile leaves sometimes pinnatisect or pinnatifid, mature leaves linear or narrow-oblong to lanceolate, serrate to biserrate, midrib prominent below, channelled above, often bearing well developed leafy shoots in the axils, giving the impression of whorled leaves. Leaves variable between species, 1-9 cm long, 0.1-1.5 cm wide, thin or thick in texture, always glabrous.

Inflorescence terminal, primary bracts decussate, only slightly reduced from vegetative leaves, and retaining all their leaf-like characteristics. Axis terminated by a simple or compound dichasium, with simple or compound dichasia of 3-15 flowers in the axils of the upper 4-7 pairs of bracts and lateral inflorescences of similar construction in the axils of leaves immediately below the terminal inflorescence and at irregular intervals down the stem. The lowest pair of bracts in the terminal inflorescence may bear 3-7-flowered auxiliary dichasia in addition to the normal ones. Primary bracts persistent at least in the lower part of the inflorescence, secondary and tertiary bracts thin, membranous, deciduous at or about anthesis. The terminal flower of the inflorescence and of the lateral dichasia develop to maturity as can some of the lateral flowers within the dichasia, but the flowers of the ultimate branches of the compound dichasia usually abort at an early stage. In *H. lucasii* the terminal flower of the inflorescence develops first, followed by the terminal flowers of the lateral dichasia in a basifugal sequence. In other species such as *H. racemosum* and *H. monospermum* all of the functional terminal flowers of the primary dichasia open ± simultaneously or in a slightly basifugal sequence. In any case, within any compound dichasium, the flowering order is in the order of branching.

Flowers showy, ± sessile or borne on pedicels 1-2 mm long. Sepals 4, deltoid, smooth or convex, lacking median basal callus. Petals 4, red or cream, navicular or planar, not hooded ± lanceolate, contorted or imbricate, (2.5-) 5-10 mm long, (0.7-) 1.5-2.5 mm wide. Stamens 8, filaments 1.0-2.5 mm long; anthers yellow, 2-3 (-7) mm long, 4-locular, opening by slits, linear or tapering towards apex, connective produced into a short ± curved apiculum, the base rounded or sagittate. Styles 4, stigma yellow or red, capitate, fimbriate. Ovary inferior, glabrous, tapering towards base, longitudinally 4-ribbed or -angled, 4-locular, septa solid, 1 ovule per locule.

Fruit obovoid, obpyramidal, shortly pedicellate and pedunculate, longitudinally 4-ribbed or 4-angled, smooth between angles, pericarp ± spongy, endocarp slightly woody. Only 1 ovule per fruit develops and occupies the entire fruit, pushing the septa to one side.

A genus of 5 species, all narrow endemics, 2 confined to south-western Western Australia, 2 to eastern New South Wales and one to north-eastern Victoria. One species, *H. lucasii*, is very rare and perhaps extinct.

Key to the species of *Haloragodendron*

(1) Fruits 4-angled lacking distinct wings, petals cream, plants smooth, not glandular.

(2) Erect tree or shrub 1-3 m tall, leaves all lanceolate, 6-8 cm long [W. Aust. species]. 1. *H. racemosum*

(2) Rounded shrub 0.5-1.5 m tall, juvenile leaves pinnatisect, adult leaves lanceolate, 1.3-1.9 cm long [N.S. Wales species]. 3. *H. monospermum*

(1) Fruits 4-winged, petals cream or red, plants smooth or glandular.

(3) Petals cream, plant smooth, leaves lanceolate [eastern species].

(4) Petals torsive (not twisted) in bud, anthers linear, not tapering, 2-3 mm long [Vict.-N.S.Wales species]. 2. *H. baeuerlenii*

(4) Petals contorted in bud, anthers tapering towards apex, 5-7 mm long [N.S.Wales species]. 4. *H. lucasii*

(3) Petals red, plant glandular, leaves linear to narrow-oblong [W. Aust. species]. 5. *H. glandulosum*

1. **Haloragodendron racemosum** (Labill.) Orchard (Figs. 1, 164-166)

Haloragodendron racemosum (Labill.) Orchard, comb. nov.

Haloragis racemosa Labillardiere Nov. Holl. Pl. Sp. 1 (1805) 100, pl. 128! [Typus: "Habitat in Terra Van Leuwin". Lectotypus (Orchard): *No. 130.* Nova Hollandia ora austro-occidentalis. Herb. Webbianum. Ex Herb. Labillardiere, FI (photograph!) Isolectotypi: *M. Labillardiere,* Nouv. Holl. Sud-ouest, G (fr.)!; "haloragis racemosa. bill. in Holl. Herb. Webbianum. Ex. Herb. Desfontaines.", FI (photograph!)]; Drake (?), in Rees, Cyclop. 16 (1811); Sprengel (ed.), Linn. Syst. Veg. ed. 16, 2 (1825) 261; Benth., Fl. Aust. 2 (1864) 480; F. v. M., Fragm. 8 (1874) 162; F. v. M., Census 1 (1882) 49; F. v. M., Sec. Census 1 (1889) 85; Schindler, Bot. Jb. 34. Beibl. 77 (1904) 30, 31, 35, 42; Schindler, Pflrch 23 (1905) 59; Britten, J. Bot. 45 (1907) 137; Gardner, Enum. (1931) 99; Praglowski, Grana 10 (1970) 180.

Cercodia racemosa (Labill.) DC., Prod. 3 (1828) 67.

Haloragis racemosa var. *angustifolia* Schindler, Pflrch 23 (1905) 59. [Typus: "West Australien: (R. Brown, F. v. Mueller, Maxwell). — Herb. Berlin, Deless., Petersb." Lectotypus (Orchard): *Maxwell,* B (probably destroyed) n.v. Isolectotypus: *Maxwell,* NSW99297 ex B! Syntypi: *R. Brown s.n.,* Bay 1., LE! MEL39235!, P! (fr.)] Ewart, Fl. Vict. (1931) 882; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 469.

FIGS.: Labill., Nov. Holl. Pl. Sp. 1 (1805) pl. 128; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 469; Praglowski, Grana 10 (1970) pl. 9 (g-i).

Small erect tree or shrub 2-3 m tall, glabrous, branching, decussate; stems square, prominently 4-ribbed, somewhat reddish. Leaves decussate, petiolate, linear-lanceolate, 6-8 (-9) cm long, 0.6-0.8 (-1.4) cm wide, widest below middle, upper part attenuated into a narrow tapering point, serrate with 40-50 distinct teeth, dark green above, paler below, midrib sunken above, prominent on undersurface, lateral veins obscure, petiole narrowly winged, merging insensibly with blade, ca 1 cm long.

Inflorescence a terminal raceme (Fig. 1). Axis monopodial, terminated by a compound dichasium of 7 flowers. Compound dichasia of 7-15 flowers are borne in the axils of the 5-6 pairs of decussately arranged bracts immediately below the apical dichasium, becoming more complex basipetally. The lowermost pair of bracts may also bear an auxiliary dichasial inflorescence of 3-7 flowers. Lateral inflorescences similar to but less complex than the terminal one are borne in the axils of the 2-3 pairs of leaves immediately below the terminal inflorescence. Within each compound dichasium all except the flowers of the ultimate branches are functional and within the inflorescence all of the functional flowers develop ± simultaneously. Primary bracts leaf-like, becoming reduced towards the apex of the inflorescence, fleshy and serrate; secondary, tertiary etc. bracts lanceolate, ± membranous and deciduous at an early stage.

Flowers cream-green on thin pedicel 1.0-1.5 mm long (Fig. 165). Sepals 4, deltoid-ovate, 0.6 mm long, 1.0 mm wide, ± smooth with faint median longitudinal rib. Petals 4, cream, navicular, torsive (not twisted), 3.0 mm long, 1.2 mm wide. Stamens 8, filaments 0.5-0.7 mm long; anthers yellow, 2.0-2.2 mm long, 0.4-0.5 mm wide at base, 4-locular, tapering slightly towards apex, connective produced into a short ± curved apiculum (Fig. 166). Styles 4, clavate, 0.8-1.0 mm long. Ovary obovoid, 1.2-1.5 mm long, 0.8-0.9 mm wide, 4-angled, smooth, 4-locular, with 2 ovules per locule, 1 of which aborts at an early stage.

Fruit obovoid, 9.0-10.0 mm long, 4.5-5.0 mm wide, 4 narrow vertical wings, almost square in transverse section, wings decurrent in pedicel and sepals; sepals persistent, erect, broad-deltoid, 0.5 mm long, 3.0 mm wide, with an indistinct median longitudinal rib; pericarp spongy, endocarp very slightly woody; 1 locular by abortion of 3 ovules, 1 seed occupying the whole fruit and pushing the septa and columella to one side.

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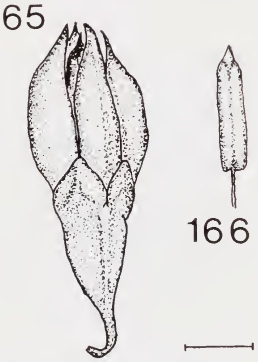

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Figs. 164-166. *Haloragodendron racemosum.* 164. Distribution. 165. Flower. 166. Stamen. (figs. 165, 166 from *Orchard 1285*). Scale represents 1 mm (figs. 165, 166).

Distribution: This species is confined to a coastal strip of south-western Western Australia from the vicinity of Esperance Bay to Cape Leeuwin and including the off-shore islands of the Recherche Archipelago (Fig. 164).

Ecology: *Haloragodendron racemosum* appears to favour sandy granitic soils. Collectors' notes include "in deep depression of granite outcrop" (*Aplin 2620*); "creek head in Karri forest" (*Baird UWA496*) and "in deep black sand in gullies" (*Royce 6225*). Flowers October to December, fruits late October to January or February.

Specimens examined:

WESTERN AUSTRALIA: Anon. s.n., Middle Island, Recherche Archipelago, MEL39233 (fl., fr.); *Anon. s.n.*, 1884, Lake Muir, MEL39237 (fl.); *Anon. 34*, summit of Mt. Lindsay, MEL39240 (fl.); *Aplin 2620*, 25.x.1963, Mt. Boyatup, PERTH (fl., fr.) — Voucher for Alkaloid Survey; *Baird s.n.*, 5.i.1933, Nornalup Inlet, UWA495 (fr.); *Baird s.n.*, 6.xii.1947, Walpole, UWA496 (fr.); *Bennett 3056*, 15.x.1969, 1 mile [2 km] from Kent River Bridge, PERTH (fl., fr.); *Brown s.n.*, 1802, Bay I., LE, MEL39235, P (fr.) — syntypes of *H. racemosa* var. *angustifolia*; *Delin* [?] *130*, Nova Hollandia ora occidentalis, FI (herb. Labill. — photo.) (fr.) — lectotype of *H. racemosa*; *Gardner 13029*, 12.xi.1960, between Frankland & Walpole Rivers, PERTH (fr.); *Humphreys s.n.*, -.x.1965, Walpole, AD97112155, PERTH (fl., fr.); *Jackson s.n.*, -.xi.1912, Bow River, NSW132764-6 (fr.); *bill.* [*Labillardiere*] *s.n.*, in holl., FI (ex Herb. Desf.) (st.) — isolectotype of *H. racemosa*; *Labillardiere s.n.*, Nouv. Holl., Sud-ouest, G (fr.) — isolectotype of *H. racemosa*; *Maxwell s.n.*, s. loc., NSW99297 (fr.) — isolectotype of *H. racemosa* var. *angustifolia*; *Maxwell s.n.*, S.W. Australia, MEL39234, 39236 (fl., fr.); *Maxwell s.n.*, on the island in Nornalup Inlet, MEL39239 (fr.); *McHardie s.n.*, 1884, Blackwood River, MEL39238 (fr.); *Meebold 1339*, -.xi.1928, Nornalup, M (fl., fr.); *Orchard 1285*, 1.x.1968, Boyatup Hill, 110 km east of Esperance, AD (fl.); *Richardson s.n.*, -.xi.1930, Frankland River, Nornalup, PERTH (fr.); *Royce 6225*, 6.ii.1960, Mondrain Island, Recherche Archipelago, PERTH (fl., fr.); *Royce 8811*, 22.x.1969, Cape le Grand, PERTH (fl.); *Webb s.n.*, 1882, Mt. Lindsay, MEL39241 (fl.); *Willis s.n.*, 7.xi.1950, Figure-of-Eight Island, Recherche Archipelago, MEL39242 (fl., fr.).

The choice of a lectotype is necessary as there are two specimens in FI both from Webb's Herbarium (see Stafleu 1967, p. 252), and both bearing labels in Labillardiere's handwriting. The sheet here designated lectotype bears three labels, the largest consisting of notes on the specimens in Labillardiere's handwriting as well as "Dr. Delin (?) No. 130. Haloragis racemosa Lab. 128." The second label also in Labillardiere's handwriting consists of the second half of his description in Novae Hollandiae Plantarum Specimen from ". . . concava, dorso carinata, utrinque acuta, . . . " to the end of the legend for the plate. The third label is printed with the words "Herb. Webbianum. Ex Herb. Labillardiere." with the locality "Nova Hollandia ora austro-occidentalis" in handwriting other than Labillardiere's. The material consists of 5 separate specimens, all apparently belonging to the same entity. The second sheet in FI consists of a single specimen and two labels. One bears the words "haloragis racemosa. bill. in Holl." in Labillardiere's handwriting, the other has the printed words "Herb Webbianum. Ex. Herb. Desfontaines." as well as the word "Haloragis" in an unknown handwriting.

In Labillardiere's description he states "rami oppositi aut alterni" and in the accompanying Tab. 128 the branches of the leafy flowering shoot are shown as all alternate. In the type material, as in all other material examined, the branching, at least in the upper part of the plant, is decussate (with the exception of occasional pseudo-alternate nodes). Tab. 128 also shows the anthers as dorsifixed and versatile, whereas they are basifixed.

A collection by R. D. Royce (no. 6225) from the Recherche Archipelago differs from the mainland material in having the fruit pericarp not spongy and possessing proportionately broader leaves with much smaller serrations. More material is required from this area to determine whether this specimen represents a distinct taxon or only a teratological variant.

H. racemosum is probably closest allied to *H. baeuerlenii* which was united with it by Schindler (1905). Apart from the major disjunction in range, they are distinguished by their fruits (4-angled in *H. racemosum;* 4-winged in *H. baeuerlenii*) and leaves (6-9 cm long in *H. racemosum*; 3.0-3.5 cm long in *H. baeuerlenii*).

2. **Haloragodendron baeuerlenii** (F. v. M.) Orchard (Figs. 167, 168)

Haloragodendron baeuerlenii (F. v. M.) Orchard, comb. nov.

Haloragis baeuerlenii F. v. Mueller, Trans. R. Soc. Vict. 24 (1888) 132. [Typus: "Between rocks in ravines on and near the summit of Mount Tingiringi, at an elevation of about 5000 feet; W. Baeuerlen." Lectotypus (Orchard): *Baeuerlen 545*, -.v.1887, Tingiringi Mountain, MEL39229 (fr.)! Syntypi: *Baeuerlen s.n.*, Tingiringi Mt, MEL39222 (wood sample)!; *Baeuerlen s.n.*, Tingiringi Mountain, MEL39224 (fr.)! *Baeuerlen s.n.*, 1885, Mt.

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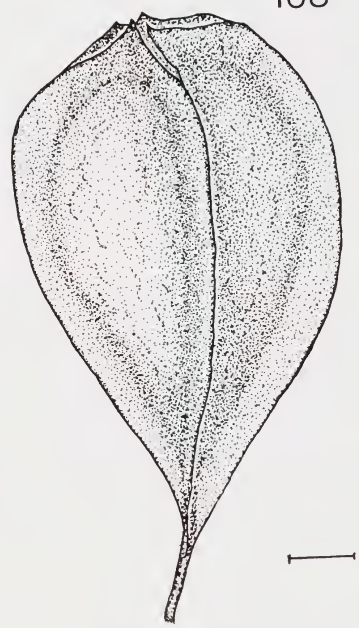

Figs. 167, 168. *Haloragodendron baeuerlenii.* 167. Distribution. 168. Fruit (from *Baeuerlen s.n.,* K). Scale represents 1 mm.

Tingiringi, MEL39225 (fr.)! *Baeuerlen s.n.,* 1887, Mt. Tingiringi, MEL39228 (st.)!, NSW99299 (fl., fr.)!; *Baeuerlen 535,* -.v.1887, Tingiringi Mntn, MEL39227 (fr.)!; *Baeuerlen 545,* -.v.1887, Tingiringi Mntn, MEL39223 (fr.)!]; F. v. M., Key Syst. Vict. Pl. 1 (1887-8) 261 ('*baeuerleni*'); F. v. M., Sec. Census 1 (1889) 85 ('*bauerlenii*'); Moore, Hdbk. Fl. N.S. Wales (1893) 185; Bailey, Qld. Flora 2 (1900) 553, 554 ('*bauerlenii*'); Schindler, Pflrch 23 (1905) 59 pro syn. *H. racemosae* [*H. Haenerlein* F. v. M. ex Schindl., l.c., nom. nud.; the reference given is incorrect.] Durand & Jackson, Ind. Kew Suppl. 1 (1906) 195 ('*baeuerleinii*'); Dixon, Pl. N.S. Wales (1906) 129; Bailey, Comp. Cat. Qld. Pl. (1913) 175.

Haloragis racemosa var. *baeuerlenii* (F. v. M.) Schindler, Pflrch 23 (1905) 59; Maiden & Betche, Census N.S. Wales Pl. (1916) 159 ('*baeuerleni*'); Ewart, Fl. Vict. (1931) 882; Willis, Hdbk. Pl. Vict. 2 (1972) 469.

Shrub or small tree up to 1.5 m tall, glabrous, branches spreading, decussately arranged. Stems reddish, prominently 4-winged and -angled. Leaves decussate, lanceolate, 3.0-3.5 cm long, 0.6-0.8 cm wide, serrate with 30-40 small simple appressed teeth; midrib sunken above, prominent below, lateral veins obscure; glabrous, dark green above, paler below; widest just below middle, on petiole 0.5-0.6 mm long.

Inflorescence racemose, terminal on young stems. Axis monopodial, terminated by a compound dichasium of 7 flowers. Simple or compound dichasia of 3-7 flowers are borne in the axils of the 3-5 pairs of primary bracts immediately below the apical dichasium, becoming more complex basipetally. Lateral inflorescences similar to but less complex than the terminal one, are borne in the axils of the pair of leaves immediately below the terminal inflorescence. Within each compound dichasium ("Paracladium") only the flowers of the ultimate branches do not develop. The terminal flower of the whole inflorescence opens first followed by the other functional flowers which develop ± simultaneously. Primary bracts similar in size and shape to the upper leaves.

Flowers showy, on thin pedicels 1.5-1.7 mm long. Dichasia usually on short thick flattened peduncles 0.5-1.0 mm long. Sepals 4, deltoid, 1.0-1.4 mm wide, 1.0-1.2 mm long, erect, slightly convex, lacking basal calluses. Petals 4, navicular, imbricate, almost flat, cream to white, 5.0-5.5 mm long, 1.8-2.0 mm wide. Stamens 8, filament fine, ca 1 mm long; anthers yellow, linear, 2.2-2.6 mm long, 0.3-0.4 mm wide, 4-celled, opening by slits, connective produced into a short curved apiculum. Styles 4, red. Ovary ovoid, 2.0-2.3 mm long, 1.5 mm wide (incl. wings), 4-winged, slightly convex between wings, otherwise smooth, glabrous; incompletely 4-celled, septa solid.

Fruit obovoid, 5.0-5.5 mm long, 4.0-4.5 mm wide (incl. wings), widest just above middle, 4-winged; the wings narrow, longitudinal, antipetalous, ca 0.5 mm wide, profusely veined in a dichotomously branching and anastomosing pattern, lacking a marginal vein, produced for a short distance below the fruit and decurrent in the pedicel; sepals persistent, erect, broadly deltoid, 2.0 mm wide, 0.5 mm long, enclosing the styles; pericarp slightly spongy, 8-ribbed, endocarp slightly woody; septa pushed to one side by the single seed (Fig. 168).

DISTRIBUTION: This species is confined to a small area on the New South Wales-Victorian border between Delegate and Wulgulmerang (Fig. 167).

Ecology: *H. baeuerlenii* is confined to the tops of mountains which end at an altitude of 900-1500 m in a rocky outcrop. The plants are usually found in crevices on the north-facing side of these outcrops. Flowering occurs from December to January and fruiting from December to June.

Specimens examined:

NEW SOUTH WALES: Anon. s.n., Broga (near Bega), MEL1003714 (st.); *Baeuerlen s.n.*, 1887, source of the Genoa, K (fr.); *Clifford s.n.*, -.vi.1888, Delegate, MEL39230 (fr.); *Forsyth s.n.*, -.i.1910, Merambego, Delegate, M, NSW99298 (fr.). *VICTORIA: Baeuerlen s.n.*, Tingiringi Mt., MEL39222 (wood sample) — syntype of *H. baeuerlenii*; *Baeuerlen s.n.*, Tingiringi Mountain, MEL39224 (fr.); *Baeuerlen s.n.*, 1885, Mt. Tingiringi, MEL39225 (fr.); *Baeuerlen s.n.*, 1887, Mt. Tingiringi, MEL39228 (st.), NSW99299 (fl., fr.); *Baeuerlen 535, 545*, -.v.1887, Tingiringi Mntn, MEL39227, 39223 (fr.) — all of the above Baeuerlen specimens are syntypes of *H. baeuerlenii; Baeuerlen 545*, -.v.1887, Tingiringi Mountain, MEL39229 (fr.) — lectotype of *H. baeuerlenii*; *Baeuerlen s.n.*, -.i.1889, Tingiringi Mntn, MEL (fl., fr.); *Beauglehole, Rogers & Finck 33376*, 7.i.1970, Ballantyne Needles, east of Wulgulmerang-Suggan Buggan road, AD, BEAUG (fr., seedlings); *Hunter s.n.*, -.xii.1939, Ballantyne's Hills, Suggan Buggan, MEL39231 (fr.); *Merrah s.n.*, -.v.1887, head of Bendoc River, MEL1003730 (st.); *Orchard 2647*, 5.xii.1970, Mt. Wheeler ca 10 km east of Wulgulmerang, AD (fl., fr.); *Orchard 2784, 2785*, 7.xii.1970, Ballantyne Hills, Suggan Buggan, AD, AK (fl., fr.).

Bailey (1900) claimed that *Haloragis baeuerlenii* was recorded for Queensland by Mueller, but cited no reference or specimens. This record is unsupported by other evidence and is extremely suspect.

The choice of a lectotype is necessary for *Haloragis baeuerlenii* because of the large number of sheets in MEL representing several different collections. Any one of these could serve as lectotype, but the one chosen has the best material.

H. baeuerlenii was considered to be a varietas of *H. racemosa* by Schindler (1905). Although these two species are closely related, they differ sufficiently in leaf and fruit characters to be maintained as distinct, and are separated by ca 1900 km.

3. **Haloragodendron monospermum** (F. v. M.) Orchard (Figs. 2, 169-171)

Haloragodendron monospermum (F. v. M.) Orchard, comb. nov.

Haloragis monosperma F. v. Mueller, Proc. Linn. Soc. N.S. Wales 10 (1885) 197 [Typus: "On heaths at the western side of the ranges near Braidwood, at an elevation of about 3000 feet; W. Bauerlen." Holotypus: *W. Baeuerlen 448*, Febr. 1885, Braidwood District, 3,200 ft., MEL39170 (fr.)! Isotypus: *W. Bauerlen s.n.*, -.ii.1885, Braidwood, NSW99302 p.p. (fr.)!]; F. v. M., Key Syst. Vict. Pl. 2 (1885) 22; F. v. M., Trans. R. Soc. Vict. 24 (1888) 137; F. v. M., Sec. Census 1 (1889) 86; Moore, Hdbk. Fl. N.S. Wales (1893) 185; Schindler, Bot. Jb. 34. Beibl. 77 (1904) 30, 31, 40; Schindler, Pflrch 23 (1905) 59; Dixon, Pl. N.S. Wales (1906) 129; Maiden & Betche, Census N.S. Wales Pl. (1916) 158; Praglowski, Grana 10 (1970) 182.

Figs.: Praglowski, Grana 10 (1970) pl. 9 (a-f).

Erect or rounded shrub 1-2 m tall, glabrous, branching decussate, stems 4-ribbed, terminating in inflorescences. Leaves decussate, sessile, juvenile leaves deeply dissected, pinnatisect to pinnatifid, adult leaves narrow lanceolate, 13-19 mm long, 1.0-1.5 (-3.0) mm wide, widest at middle, apex acute, slightly narrowed towards base, midrib channelled above, ± prominent below, margin finely serrate in upper ½-⅔ with 10-15 teeth. Vegetative leaves often bearing leafy shoots in their axils, giving the impression that the leaves are whorled.

Inflorescence terminal on young stems (Fig. 2). Axis monopodial, terminated by simple dichasium or monochasium of 1-3 flowers. Simple or compound dichasia of 3-7 flowers are borne in the axils of the 6-7 pairs of primary bracts immediately below the terminal dichasium becoming more complex basipetally. Lateral inflorescences similar to but less complex than the terminal one are borne in the axils of the leaves below the terminal inflorescence. Within the dichasia all flowers except those of the ultimate branches are functional, and usually all of the functional flowers form fruits. The order of flowering within the inflorescence is basifugal, the terminal flower opening last; the terminal inflorescence developing before the lateral ones. Primary bracts green, leaf-like, reduced to about half normal leaf size in the upper part of the inflorescence, secondary bracts lanceolate, ca 0.5 mm long, 0.1 mm wide, membranous; tertiary bracts ca 0.2 mm long, 0.05 mm wide; secondary and tertiary bracts deciduous at or before anthesis.

Flowers on pedicels 0.5-0.8 mm long, peduncle very short (Fig. 170). Sepals 4, deltoid, 0.7 mm long, 0.8 mm wide, smooth. Petals 4, cream, shallow-navicular, almost flat, slightly keeled, apparently acute at tip in bud, but actually rounded, 4.5-5.0 mm long, 1.4-1.6 mm wide. Stamens 8, filaments 1.0-1.3 mm long; anthers yellow, 3.1-3.6 mm long, 0.2-0.3 mm wide, 4-locular, tapering slightly towards apex, ± sagittate at base, connective produced into small apiculum at apex. Styles 4, yellow, 0.7 mm long including orange capitate stigmas. Ovary obpyramidal, 4-angled, ca 1.2 mm long, 1.0 mm wide.

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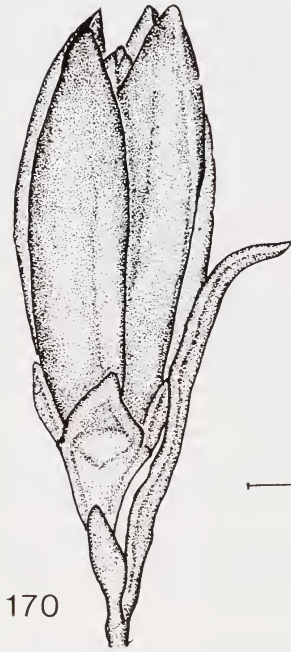

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Figs. 169-171. *Haloragodendron monospermum.* 169. Distribution. 170. Flower at tip of inflorescence (from *Gauba s.n.*, CBG013194). 171. Fruit (from *Wrigley s.n.*, CBG023487). Scale represents 1 mm (figs. 170,171).

Fruit ± sessile, on pedicel 0.5 mm long, ± oblong, 3.5-3.7 mm long, 1.7-2.0 mm wide, tapering towards base, 4 sharp slightly verrucose angles opposite the petals, 4 indistinct smooth rounded ribs opposite sepals, otherwise smooth, slightly swollen at apex; sepals persistent, erect, broad-deltoid, 1.2 mm wide, 0.6 mm long; 4-locular, septa solid, pushed to one side by single seed (Fig. 171).

Distribution: Confined to the mountains near Braidwood, New South Wales, at an altitude of 600-1200 m, plus one specimen from near Kybean (Fig. 169).

Ecology: Grows on granitic soils at elevations of 600-1200 m. The plants from the Corang River were growing on the floodplain of the river bed. Flowers are present from late October to December, and fruits from December to February or March.

Specimens examined:

NEW SOUTH WALES: Baeuerlen s.n., -.ii.1885, Braidwood, NSW99302 p.p. (fr.) — holotype of *Haloragis monosperma; Baeuerlen s.n.*, -.xi.1886, Braidwood, NSW99302 p.p., P (fl.); *Baeuerlen s.n.*, -.xii.1886, Charley's Forest, Braidwood District, BRI080071 (fl.); *Baeuerlen s.n.*, ante 1887, near Braidwood, G (Herb. DC.) ex MEL (fl.); *WB.* [*Baeuerlen?*] *s.n.*, -.xi.1888, Corang River, NSW99304 (fl.); *Boorman s.n.*, -.iii.1909, Currocobilly Mnt., Braidwood, NSW99303 (fr.); *Boorman s.n.*, -.ii.1910, Currockbilly, AD9620066 ex NSW (st.); *Cambage 1897*, 4.xi.1908, Kybean, near Kydra Trig Station, NSW (st.); *Gauba s.n.*, 10.xi.1957, East of Braidwood, CBG 013194 (fl.); *Lee 70*, 5.xi.1970, Mongarlowe River crossing, NSW (fl., fr.); *Mueller s.n.*, Braidwood, M (fl.); *Orchard 2389, 2390, 2391, 2392*, 29.x.1969, Corang River at crossing of the Nerriga-Braidwood road, AD, AK (fl.); *Wrigley s.n.*, 4.xii.1967, Corang River, Braidwood-Nerriga road, CBG023487 (fl., fr.); *Phillips s.n.*, 18.x.1961, Cult. Jervis Bay Bot. Garden Annexe, ex Corang River, CBG014792 (fl.).

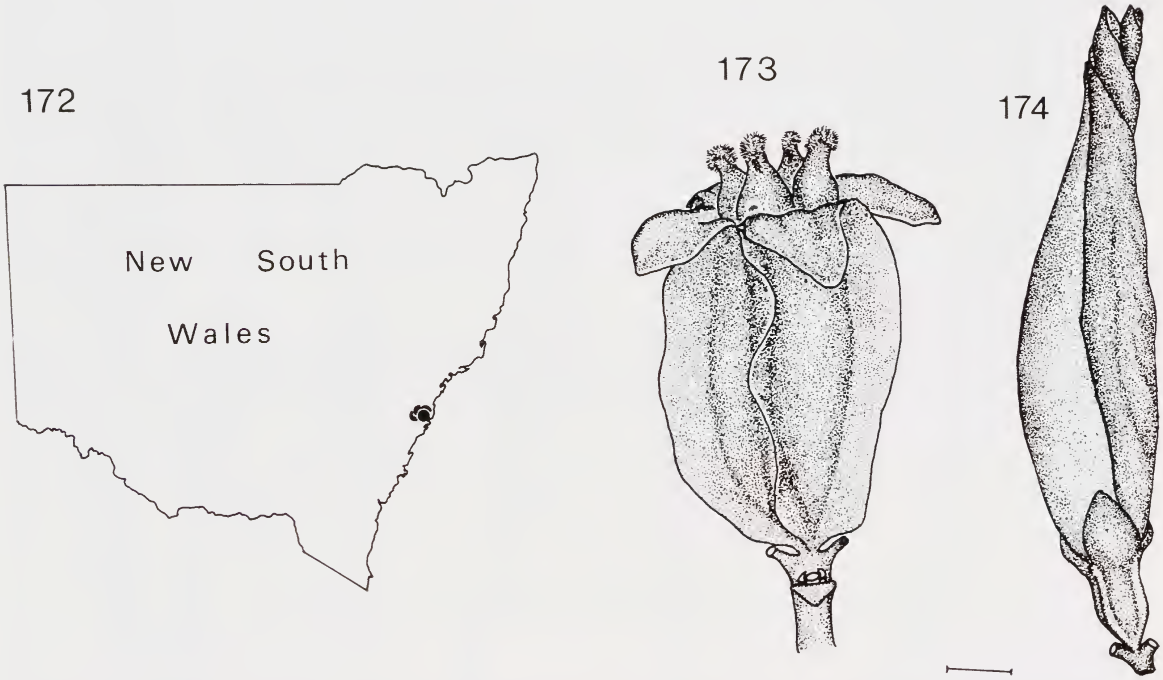
Mueller (1885) records this species for eastern Victoria, in the Gippsland area. No collections have been seen to support this statement, but the species is known from New South Wales, adjacent to the Victorian border.

The relationships of *H. monospermum* are obscure, but probably lie with *H. baeuerlenii*.

4. **Haloragodendron lucasii** (Maid. & Betche) Orchard (Figs. 4, 172-174)

Haloragodendron lucasii (Maid. & Betche) Orchard, comb. nov.

Halorrhagis lucasii Maiden & Betche, Proc. Linn. Soc. N.S. Wales 34 (1909) 358 ('*lucasi*'). [Typus: "A. H. S. Lucas, in a wild gully near Gordon, Port Jackson, November, 1908." Holotypus: *A. H. S. Lucas*, In a wild gully near Gordon, -.x.1908, NSW113167 (fl., young fr.)! Isotypi: *A. H. S. Lucas*, -.x.1908, Gordon, AD96905159 ex NSW



Figs. 172-174. *Haloragodendron lucasii.* 172. Distribution. 173. Flower. 174. Terminal fruit of infructescence. (figs. 173, 174 from *Blakely s.n.,* AD96920067). Scale represents 1 mm (figs. 173, 174).

(st.)! *A. H. S. Lucas,* -.x.1908, Near Gordon in the Port Jackson district, G (Herb. Pitard-Briau) ex NSW!, MEL1003576 ex NSW (fl., fr.)!]; Maiden & Betche, Census N.S. Wales Pl. (1916) 158; Evans, in Beadle, Evans & Carolin, Hdbk. Vasc. Pl. Syd. (1963) 175; Praglowski, Grana 10 (1970) 182: Beadle et al., Fl. Syd. Reg. (1972) 206.

Figs.: Maiden & Betche, Proc. Linn. Soc. N.S. Wales 34 (1909) pl. 31; Praglowski, Grana 10 (1970) pl. 9 (k-m).

Erect shrub up to 1 m tall, glabrous, stems arranged decussately, 4-winged. Leaves decussate, sessile, oblanceolate, 2.5-3.0 (-4.5) cm long, 0.4-0.5 cm wide, widest about two-thirds of way to acute apex, midrib channelled above, prominent below, lateral veins not visible, coriaceous, darker green above than below, serrate to biserrate, 10-16 serrations per leaf mainly in the upper ½ to ⅔.

Inflorescence racemose, terminal on young stems (Fig. 4). Axis terminated by a simple dichasium, with simple dichasia in the axils of the upper 3-4 pairs of primary bracts. Lateral inflorescences similar to the terminal one but extending over only 1-3 nodes, are borne in the axils of the 3-6 pairs of leaves immediately below the terminal inflorescence. Within each inflorescence, the terminal flower of the terminal dichasium develops first, followed by the terminal flowers of the two lowest dichasia. The terminal flowers of the intermediate dichasia then open in basifugal order. The lateral flowers of each dichasium abort. Primary bracts similar in size and shape to upper leaves. Secondary bracts brown, opaque, lanceolate, ± 2 mm long, 0.4 mm wide, entire, deciduous before anthesis, tertiary bracts extremely minute, deciduous early with lateral flowers of the dichasium.

Flowers ± sessile on peduncle 0.3 mm long (Fig. 173). Sepals 4, broad-deltoid, 1.0 mm long, 1.5 mm wide, erect. Petals 4, creamy white, strongly twisted in bud, very shallow navicular (almost planar) in flower, lanceolate, 9.5-12 (-14) mm long, 2.0-2.5 mm wide, becoming twisted again before being shed. Stamens 8, filaments 1.5-2.5 mm long; anthers yellow with reddish connective, narrowly sagittate, (4.0-) 5.5-7.0 mm long, 0.6 mm wide at base, somewhat compressed, tapering to a blunt point at the apex. Styles 4, conical at first, later capped with a saddle-shaped fimbriate stigma. Ovary glabrous, ellipsoid, with four longitudinal antipetalous wings 0.5 mm wide; 4.2 mm long, 2.5 mm wide (incl. wings).

Fruit not seen mature. Borne on pedicel 0.2-0.5 mm long on peduncle 0.5-1.0 mm long (Fig. 174).

Distribution: Confined to New South Wales in the vicinity of Ku-Ring-Gai Chase, a reserve near Hornsby in the north-west suburbs of Sydney. Last collected in 1926, the species is very rare or extinct. Searched for in vain, 29th October, 1969. (Fig. 172).

Ecology: Very little known. Flowers August to November, fruits present in October.

SPECIMENS EXAMINED:

NEW SOUTH WALES: Blakely s.n., -.xi.1915, Turramurra Range, Hornsby, NSW99294 (fl., young fr.); *Blakely s.n.*, -.viii.1916, Kuringai Chase, Hornsby, AD96920067, BRI080045, SYD (fl., young fr.); *Blakely s.n.*, 15.ix.1918, 2½ miles [4 km] east of Hornsby, NSW99296 (fl.); *Blakely s.n.*, -.ix.1920, Kuring-gai Chase, 2½ miles [4 km] E. of Hornsby, NSW99295 (fl., young fr.); *Blakely, Lucas & Shiress s.n.*, 14.viii.1926, about 3 miles [5 km] due E of Hornsby railway station, AD96921184 (fl.); *Lucas s.n.*, -.x.1908, In a wild gully near Gordon, NSW113167, G (Herb. Pitard-Briau), MEL1003576, AD96905159 (fl.) — types of *H. lucasii.*

In Maiden and Betche's original description of *Haloragis lucasii* they give the date of collection of the type specimen as November, 1908. The date on the holotype (NSW) and the three isotypes (AD, G, MEL) is clearly stated as "10.1908".

The buds in the type specimens have the petals twisted in a dexter direction (as viewed from outside) while all other collections have them twisted in a sinister direction. In all cases however, the type of imbrication is the same, with the right hand margin of the petal visible, and covering the left hand side of the adjacent petal.

The relationships of this species are obscure. The twisted petals of the buds do not occur elsewhere in the family.

5. **Haloragodendron glandulosum** Orchard (Figs. 3, 175-181)

Haloragodendron glandulosum Orchard, sp. nov.

Frutex parvus glaber, caules 4 alati glandibus multis stipitatis rubris vestiti. Folia linearia ad angusto-oblonga sessilia 0.9-1.4 cm longa 0.2-0.4 cm lata serrata glandibus in marginibus. Flores rubri, petala navicularia, antherae luteae apiculatae 1.5-2.0 mm longae. Fructus rubri-purpurei 4-alati obpyriformes; alae in pedicellum decurrentes ad apices auriculatae. Semen 1, septa ad laterem depulsa.

Typus: *Hj. Eichler 21105,* 9.ix.1971, Western Australia. South-West Division, Shire of Oldfield. Kundip, ca 20 km south of Ravensthorpe, along roadside, on gravel of Ravensthorpe-Hopetoun road. (Same as 21106, but from different plant). Holotypus: AD97144017 (fl.)! (Fig. 175). Isotypi: B, L, UC, W.

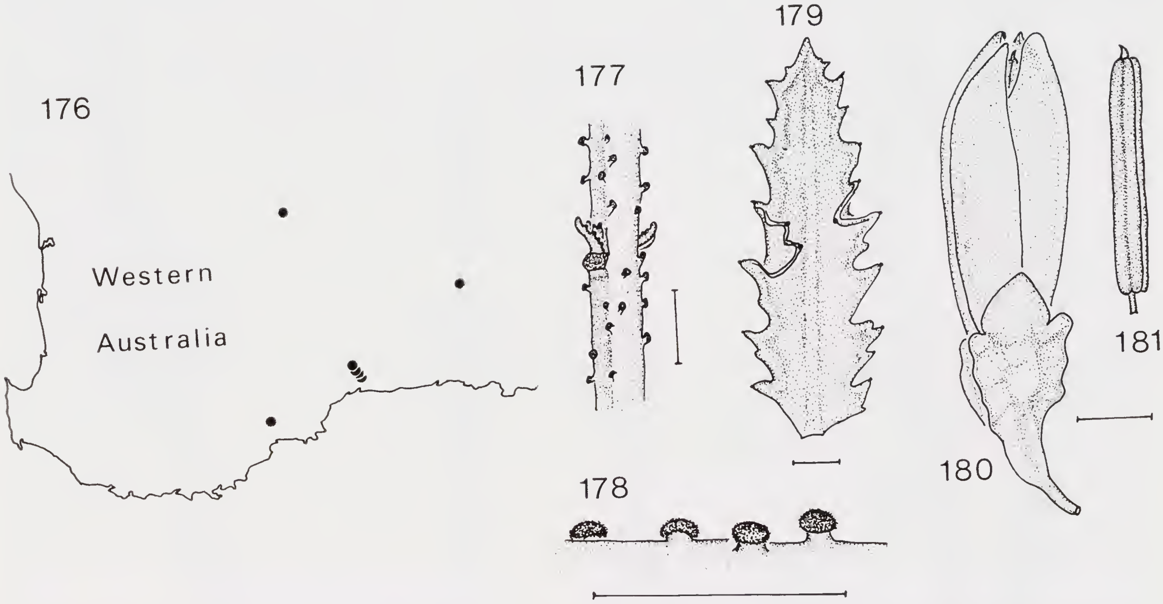
Small glabrous shrub, 1-1.5 m tall, stems erect, 4-angled with numerous scattered red, stalked glands on wings (Figs. 177, 178). Leaves decussate, with usually well developed shoots in the axils, sessile, linear to narrow-oblong, 0.9-1.4 cm long, 0.2-0.4 cm wide, irregularly serrate to biserrate, the tip of each serration bearing a gland as on the stems, coriaceous, midrib channelled above, prominent below (Fig. 179).

Inflorescence a terminal raceme (Fig. 3). Axis monopodial, terminated by a simple dichasium. Simple or compound dichasia of 3-7 flowers are borne in the axils of the 8-9 pairs of decussately arranged bracts immediately below the terminal dichasium, becoming more complex basipetally. Within each dichasial group, all except the flowers of the ultimate branches are functional (except for the terminal dichasium, where all flowers may abort), and the functional flowers within the inflorescence develop basifugally. Lateral inflorescences are borne in the axils of the leaves immediately below the terminal inflorescence. Primary bracts leaflike, fleshy, serrate, with stalked glands on tips of serrations, reduced to about half leaf size at apex. Secondary bracts similar to primary bracts, ca 2 mm long, 1 mm wide, serrate and glandular. Tertiary bracts ca 1 mm long, 0.5 mm wide, 2-5-serrate, glandular tips; all bracts ± persistent.

Flowers tetramerous, on pedicels 0.2-0.5 mm long. Sepals 4, pink, smooth, deltoid, 0.8-1.2 mm long, 0.7-1.0 mm wide. Petals 4, pink-red, navicular, non-unguiculate, 5.0 mm long, 0.7-1.0 mm wide (keel to margin). Stamens 8, filaments 0.3-0.5 (-1.0) mm long; anthers yellow, linear, 3.2-4.0 mm long, 0.3-0.4 mm wide, 4-celled, connective produced into a curved apiculum, antipetalous anthers 0.5-0.8 mm shorter than antisepalous ones (Fig. 181). Styles 4, 0.8-0.9 mm long, stigmas capitate. Ovary pink to red, obpyriform, 1.5 mm long, 1.0 mm wide, strongly 4-winged opposite the petals, wings ± lobed at apex, decurrent in pedicel below; 4-locular with one ovule per locule (Fig. 180).

Up to 3 fruits matured per dichasium, usually reddish-purple, on pedicel 3.0-4.0 mm long, obpyriform, 6.5-7.0 mm long (includ. wings), 4.5-5.0 mm wide, 4-winged, the wings decurrent in the pedicel at the base and produced into auricles at the apex, hiding the persistent, deltoid sepals. Fruit incompletely 4-locular, septa formed only at top and sides, pericarp ± woody, 1 seed, occupying entire fruit.

Fig. 175. Holotype of *Haloragodendron glandulosum*.



Figs. 176-181. *Haloragodendron glandulosum.* 176. Distribution. 177. Part of young stem showing prominent glands. 178. The same, showing details of glands. 179. Leaf. 180. Flower. 181. Stamen (figs. 177-181 from *Eichler 21106*). All scales represent 1 mm.

Distribution: *H. glandulosum* is relatively widespread in south-western Western Australia from the vicinity of Southern Cross to Ravensthorpe (Fig. 176).

Ecology: Collectors' notes include "common along roadside, on clay" (*Bennett 2999*); "in clay soil with *Euc.* [*Eucalyptus*] *platypus*" (*George 1618*); "on clay" (*Newby 3455*); "in sandy soil in burnt country" (*Royce 10233*). Flowering takes place from September to November, and fruiting from October to December).

Specimens examined:

WESTERN AUSTRALIA: Aplin 2705, 27.x.1963, nr Kundip, AD, PERTH (fr.); *Bennett 2999,* 1.x.1969, 20 miles [32 km] N of Hopetoun, PERTH (fl.); *Brockway 3,* -.x.1946, 30 miles [48 km] south of Moorine Rock, PERTH (fr.); *Davies 103,* -.xii.1962, Daniell, PERTH (fl., fr.) — pollen sent to Palyn. Lab. Stockholm sub nom. *Haloragis aculeolata*; *Eichler 21105,* 9.ix.1971, Kundip, ca 20 km south of Ravensthorpe, AD (fl.) — type of *H. glandulosum*; *Eichler 21106,* 9.ix.1971, l.c., different plant, AD (fl.); *Gardner s.n.,* -.xi.1944, Ravensthorpe district, PERTH (old fls., fr.); *Gardner s.n.,* 25.xi.1964, s.l. PERTH (fr.); *George 1618,* 13.x.1960, 13 miles [21 km] S. of Ravensthorpe, PERTH (fr.); *Newby 3455,* 24.x.1971, 24 miles [38 km] SE of Ongerup, PERTH (fl., fr.); *Royce 10233,* 10.xii.1971, Frank Hann National Park, PERTH (fr.); *Steedman s.n.,* -.xii.1929, Forrestania, PERTH (fr.).

The relationships of this species are obscure, although in flower and fruit characteristics it comes closest to *H. racemosum.* The stalked glands which densely clothe the leaf and bract margins and ribs of the stems are unique in the family, perhaps approached only by the papillose hairs of *Haloragis platycarpa.* The specific epithet refers to this distinctive feature of the plants.

Genus **GLISCHROCARYON**

Glischrocaryon Endl., Ann. Wien Mus. 2 (1838) 209. [Type species: *Glischrocaryon roei* Endl., l.c. 210]; Endl. & Fenzl, Nov. stirp. Dec. 9 (1839) 78; Meisner, Gen. 1 (1841) 328, 2 (1841) 240; Orchard, Taxon 19 (1970) 823.

Loudonia Lindl., Sketch Veg. Swan R. Col. (1840) 42 [Type species: *Loudonia aurea* Lindl. l.c.] (non *Loudonia* Bert. ex Hook., Bot. Misc. 3 (1833) 193, nom. inval.) Endl., Gen. (1840) 1197; Endl., Enchir. Bot. (1841) 640; Walp., Rep. 2 (1843) 100; Meisner, Gen. 2 (1843) 356; Nees, in Lehm.. Pl. Preiss. 1 (1844) 159 ['*Laudonia*']; Walp., Ann. 1 (1848) 293, 4 (1858) 683, 7 (1870) 938; Lindley, Veg. Kingd. 3 ed. (1853) 723; Loudon, Encycl. Pl. (1855) 1354; Benth., Fl. Aust. 2 (1864) 471; Benth. & Hook., Gen. Pl. 1 (1865) 674; Hereman (ed.), Paxton's Bot. Dict. (1868) 344; Eichl., Bluethendiagr. (1875) 463, 464; Baill., Nat. Hist. Pl. 6 (1877) 479, 500; F. v. M., Census 1 (1882) 49, Sec. Census 1 (1889) 85; F. v. M., Key. Syst. Vict. Pl. 2 (1885) 22, 1 (1887-8) 259; Tate, Fl. S. Aust. (1890) 100; Moore, Hdbk. Fl. N.S. Wales (1893) 184; Petersen, Pflfam. 3 (1893) 231; Dalla Torre & Harms, Gen. Siph. (1900-1907) 361, 625; Diels & Pritzel, Bot. Jb. 35 (1904) 44; Schindler, Pflrch 23 (1905) 17; Dixon, Pl. N.S. Wales (1906) 129; Maid. & Betche, Census (1916) 158; Black, Fl. S. Aust. (1926) 429; Ewart, Fl. Vict. (1930) 879; Gardner, Enum. (1931) 99; Black, Fl. S. Aust. 2 ed. (1952) 640; Gardner, Wildfls W. Aust. (1959) 120; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 463-464; Willis, Hdbk. Pl. Vict. 2 (1972) 467.

Glabrous, erect, perennial herbs 10-100 cm tall; rootstock woody, roughly corticated, branched at apex, bearing numerous annual stems. Stems smooth, green, pithy, ± unbranched except at base, often ± leafless. Leaves alternate, often deciduous, terete to narrow lanceolate or linear, 1-2 (-6) cm long, 0.1-0.3 (-0.5) cm wide, acute or minutely mucronate at tip, sessile, margin entire, ± fleshy, veins and midrib obscure, sometimes bimorphic and then the juvenile forms are shorter and narrower than the adult form.

Inflorescence terminal, cymose, pseudo-umbelliform. Floral axis terminated by a compound dichasium of (7-) 15-31 flowers with (2-) 4-5 alternately arranged dichasia of 7-63 flowers below. All flowers functional or those of the ultimate branching aborted. Peduncles of the lower dichasia long and usually adnate to the lower part of their subtending primary bract. Lateral inflorescences similar to, but usually of a lesser order of branching than the terminal one, borne irregularly in the axils of the upper leaves. Primary bracts leaflike, green, fleshy, narrow lanceolate to oblanceolate, 0.5-1.0 cm long, 1-3 mm wide, sometimes absent in upper part of inflorescence; secondary bracts similar in shape, 1-2 mm long, 0.5 mm wide, membranous, often deciduous at or about anthesis; tertiary, quaternary, etc., bracts less than 1 mm long.

Flowers yellow or cream, 2- (3-) 4-merous, borne on filamentous pedicels 1-3 mm long, on short thick peduncles. Sepals 2 or 4, deltoid, 0.3-0.7 (-1.0) mm long, 0.8-1.2 mm wide, smooth, margin entire or ± erosus, decurrent in wings of the ovary or free. Petals 2 or 4, cream or yellow, torsive, navicular or hooded, 2-4 mm long, 0.7-1.0 mm wide (margin to keel). Stamens 4 or 8, filaments white or yellow, 0.5 mm long; anthers yellow, linear-oblong, length 1.5-3.0 mm, width 0.3-0.6 mm, 4-celled, the connective usually produced into a short apiculum, antisepalous anthers often up to 0.5 mm longer than antipetalous anthers. Styles 2 or 4, cream-yellow, (0.5-) 0.7-1.4 mm long, stigmas capitate, ± shortly fimbriate. Ovary inferior, yellow, obovoid to obpyriform, 0.9-3.5 mm long, 1.5-2.5 mm diam. (incl. wings), 2- or 4-winged, the wings decurrent in the pedicel, and confluent with the sepals (except *G. roei*), body of the ovary swollen or not swollen, 1 locule with 4 pendulous ovules (of which only 2 are functional in *G. behrii*) and central columella (no septa).

Fruit cream or yellow (sometimes reddish), ovoid to obovoid (flattened in *G. behrii*), 2- or 4-winged or -ribbed, the wings membranous, with radiating dichotomous veins, no marginal vein, (0.5-) 1.5-3.5 mm wide, decurrent in sepals (except *G. roei*) and pedicel (the wings in *G. flavescens* and *G. roei* are reduced to ribs 0.5 mm wide), pericarp between wings swollen or membranous, endocarp slightly woody; 1 seed, occupying the entire locule.

A genus of 4 species, 1 confined to Western Australia, 1 to South Australia, Victoria and New South Wales, and two having a disjunct Western Australia-South Australia distribution.

Key to the species and varieties of *Glischrocaryon*

(1) Flowers and fruits 4-merous [S. Aust., W. Aust.].

(2) Petals navicular, tips reflexed in bud, flowers usually cream, plants 75-90 cm tall, stems (3-) 5-8 mm diam. [S. Aust., W. Aust.]. 1. *G. flavescens*

(2) Petals hooded (± navicular in *G. roei*), tips not reflexed in bud, flowers bright yellow or sometimes reddish, plants 30-40 (-100) cm tall, stems 1-3 (-4) mm diam. [S. Aust., W. Aust.].

(3) Ovary not swollen or only concavely swollen between wings in bud, body of fruit ovoid or narrow ovoid, wings always pronounced, (2.0-2.5 mm wide, sometimes swollen at base), sepals enlarged in fruit, sepals 1.5-2.2 mm wide, 0.5-0.7 mm long. [S. Aust., W. Aust.]. 2. *G. aureum*

(4) Mature leaves oblanceolate, 3.0-6.0 cm long, 2.0-5.0 mm wide, juvenile leaves flattened, linear-lanceolate, 1.0-2.0 cm long, 0.1-0.15 cm wide. [W. Aust.]. var. *aureum*

(4) Mature leaves linear to linear-lanceolate, 0.8-2.5 (-4.0) cm long, 0.1-0.15 cm wide, juvenile leaves ± terete, 0.6-0.7 cm long, 0.5 mm wide [S. Aust., W. Aust.] var. *angustifolium*

(3) Ovary convexly swollen between wings in bud, body of fruit globular, wings almost absent (up to 0.5 mm wide), sepals not enlarged in fruit, sepals 0.7-1.2 mm wide, 0.5-0.6 mm long. [W. Aust.]. 3. *G. roei*

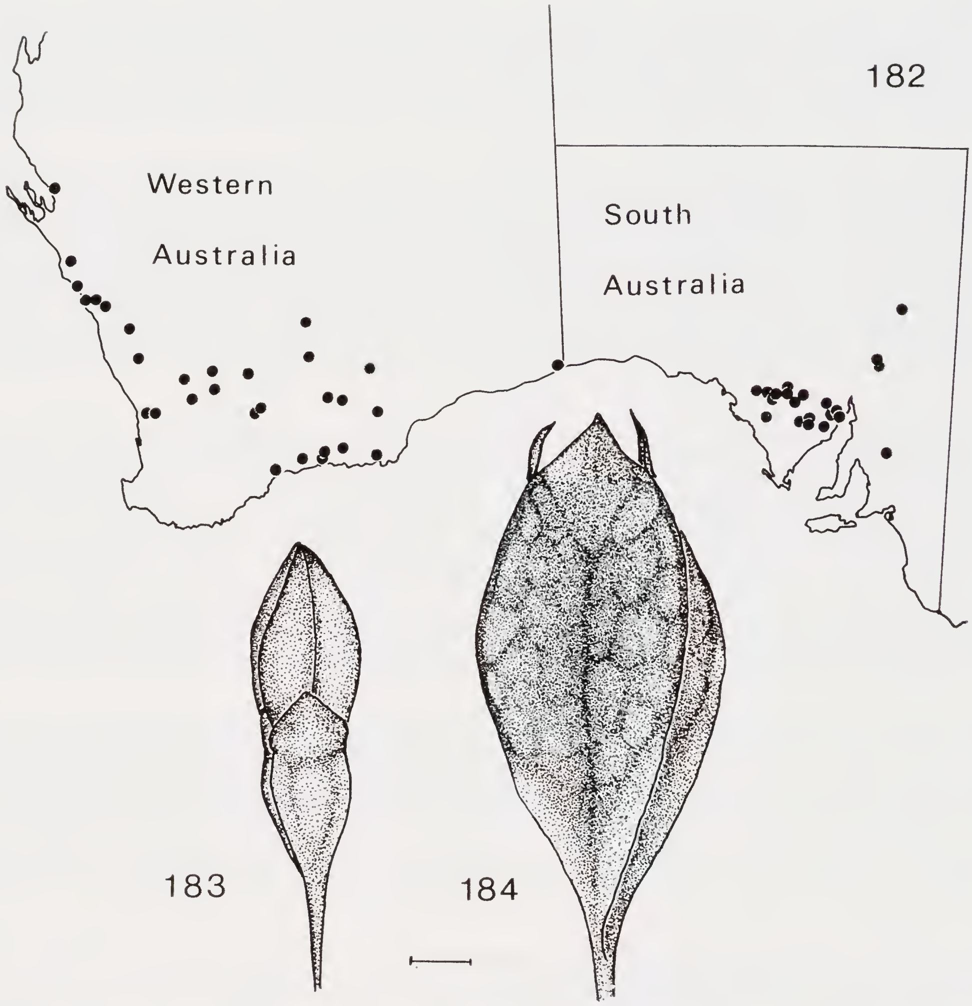
(1) Flowers and fruits 2-merous. [S. Aust., Vict., N.S. Wales]. 4. *G. behrii*

1. **Glischrocaryon flavescens** (Drumm. ex Hook.) Orchard (Figs. 5, 182-184)

Glischrocaryon flavescens (Drummond ex Hook.) Orchard, Taxon 19 (1970) 824.

Loudonia flavescens Drummond ex Hook., Lond. J. Bot. 1 (1842) 396; [Typus: none cited. Lectotypus: (Orchard): *J. Dr. 73, Loudonia flavescens* Drummond. W.A., MEL39531 (fr.)! Isolectotypi (?): *Drummond 73,* 1843, Swan River, G (herb. Boiss.)! LE!, P! (fl., fr.)]; F. v. M., Linnaea 25 (1853) 385.

Loudonia citrina F. v. M., Linnaea 25 (1853) 385 [Typus: "Ad latus occidentale montium Flinders range secus ripas glareosis, nec non inter rupas apicales montium Elders range et prope Cudnaka." Lectotypus (Orchard): *Mueller s.n.,* Oct. 51, Auf den steinigen Berggipfeln der Elder-Range und nordwestlich von Cudnaka, dann



Figs. 182-184. *Glischrocaryon flavescens*. 182. Distribution. 183. Flower. 184. Fruit. (figs. 183, 184 from *Orchard 1702*). Scale represents 1 mm (figs. 183, 184).

auch nicht selten im Geroll der Flussbetten an der Westseite des Flinders Gebirgs, MEL39545 (fl., fr.)! Syntypi: *Mueller s.n.*, Oct. 51, Flinders Range, MEL39632 (fl.)!; *Mueller s.n.*, Flinders Range, MEL39637 (fl.)!; *Mueller s.n.*, Oct. 51, inter rupes apicales montium prope Cudnaka, MEL39558 (fl.)!; *Government Botanist, Melbourne s.n.*, 1851, Elders Range, MEL39556 (fl., fr.)!]

Glabrous, clump-forming, perennial herb 75-90 cm tall. Rootstock perennial, woody, simple taproot or shortly branching at apex, 1-2 cm diam., thickly corticated. Stems numerous, stout, annual, erect, (3-) 5-8 mm diam., pithy, ± unbranched except in forming axillary inflorescences, smooth, green, often ± leafless, terminating in corymbose inflorescences. Leaves alternate, sessile, linear to narrow-lanceolate, 2-3 (-6) cm long, 1.5-2.5 (-3.0) mm wide, tapering towards apex, slightly concave above, midrib indistinct, sunken above, prominent below, lateral veins not apparent.

Inflorescence a terminal pseudo-umbelliform compound dichasium (Fig. 5). Axis terminated by a compound dichasium of 31 flowers, with 2 alternately arranged compound dichasia of 31 flowers on the axis below. Two alternately arranged lateral inflorescences are borne immediately below the terminal inflorescence. All flowers functional and usually produce seed. Peduncles of lower dichasia long, thickened, adnate to the basal part of the subtending primary bract, resulting in the bract apparently arising some distance along the branch it subtends. Similarly for all bracts except those of the ultimate and penultimate branching. Primary bracts persistent, green to yellow, lanceolate, 5.5-6.0 mm long, 1.2-1.4 mm wide.

Flowers cream to sulphur yellow, paler than in other species; sepals 4, deltoid, 0.6-0.7 mm long, 0.9-1.3 mm wide, smooth. Petals 4, navicular, very shortly unguiculate, torsive, prominently keeled, tips ± reflexed in bud, 3.4-3.9 (-4.5) mm long, 0.8-1.0 mm wide (keel to margin). Stamens 8, filaments white or yellow, relatively thick, ca 0.5 mm long; anthers yellow, linear, 2.0-2.6 (-3.2) mm long, 0.3-0.4 (-0.6)

mm wide, 4-locular, the antisepalous ones ca 0.5 mm longer than antipetalous ones, connective produced into a short apiculum (sometimes absent in W.A. specimens). Styles 4, cream-yellow, 0.9-1.0 mm long, capped by very shortly fimbriate orange-yellow capitate stigmas. Ovary obovoid (obpyramidal), 0.9-1.5 mm long, 0.8-1.0 mm wide, 4-winged, the wings decurrent in the pedicel and sepals, with numerous radiating veins but no marginal vein; 4-ovulate, one locule with central columella (Fig. 183).

Fruit cream, on pedicel ca 3.5 mm long, ovoid-oblong, 0.5-6.5 mm long, 3.0-3.5 (-4.0) mm wide, 4-winged, pericarp swollen, spongy between wings, wings 0.5 mm wide, ± membranous at margin, swollen at base, decurrent in sepals and pedicel; styles persistent, erect, 1.0-1.2 mm long, surrounded by tube formed of connate sepal bases, tips of sepals free, broad deltoid, 0.5-0.8 mm long, 1.2-1.7 (-2.0) mm broad; one seed, filling entire locule (Fig. 184).

Distribution: *G. flavescens* has a disjunct distribution, comprising south-western Western Australia in the Esperance-Norseman district, and South Australia in Northern Eyre Peninsula and the Flinders Range (Fig. 182).

Ecology: In higher rainfall areas within its range, *G. flavescens* grows on deep sand (e.g. near Esperance) while in lower rainfall areas (e.g. Norseman in Western Australia, and all localities in South Australia) it grows on rocky hillsides. Collectors' notes include "on red soil" (*Beard 2093*); "on roadside in white sand dune" (*Orchard 1227*); "perennial herb on rocky hillock" (*Burbidge 2720*). Flowers are present from (August-) September to December, and fruits from (October-) November to February.

Specimens examined:

WESTERN AUSTRALIA: Anon. 17, 24.xi.1894, Southern Cross, AD (fr.); *Aplin 1471,* 22.v.1962, 8 miles [13 km] north of Watheroo, PERTH (fl., fr.) — voucher for Alkaloid survey sub nom. *L. aurea; Beard 2093,* 28.ix.1962, Binnu, north of Geraldton, PERTH (fl.); *Brittan s.n.,* 12.vii.1951, 104 miles [166 km] W of Esperance, UWA502 (fl.); *Brockway s.n.,* -.x.1947, Murchison District, PERTH, CANB26628, CANB192882 (fl., fr.); *Burbidge 2720,* 30.ix.1947, Lake Cowan, 5 miles [8 km] NW of Norseman, CANB (fl.); *Crawford 80,* 1887, Betw. Vict. Springs and the W. end of the Great Bight, MEL (fr.); *Drummond 73,* 1843, Swan River, G, LE, MEL39531, P (fl., fr.) — types of *L. flavescens*; *Drummond 74,* 1843, Swan River, MEL, P (fr.); *Eichler 20167,* 10.x.1968, Location 1109, Shire of Esperance, AD (fl.); *Eichler 20263,* 15.x.1968, Location 1158, Shire of Esperance, AD (fl., fr.); *Genoni 25186,* -.xi.1934, Farm Etna, Broomhill, M (fr.); *George s.n.,* 13.x.1963, 4 miles [6 km] S of Cundeelee Mission on road to Zanthus, PERTH, (fr.); *Grieve s.n.,* 14.ii.1959, 10 miles [16 km] W. of Tammin, UWA512 (fl., fr.); *Helms s.n.,* 2.xi.1891, nr. Fraser Range, MEL39536 (fl., fr.); *Helms s.n.,* 12.xi.1891, near Gnarlbine, MEL39535 (fl., fr.); *Helms s.n.,* -.x.1898, Northampton, M, NSW98840 (fl.); *Jutson 165,* -.xii.1916, Comet Vale, NSW (fl.); *Koch 2953,* 9.xi.1923, Merredin, MEL (fr.); *Lullfitz 3065,* 5.xii.1963, 127 mile peg on Wyalkatchem Rd., PERTH (fr.); *Lullfitz L3842,* 25.xi.1964, Lake Cronin, 3½ miles [6 km] north of Cross Roads, PERTH (fr.); *Maxwell s.n.,* Phillips River, MEL39643 (fr.); *McLean s.n.,* 6.v.1934, Gutha, UWA511 (fl.); *Meebold 1625,* -.xi.1928, Farm Etna, Broomhill, M (fl., fr.); *Merrall s.n.,* 1888, Golden Valley, MEL39677 (fr. — terat.); *Merrall s.n.,* 1889, Lake Brown, MEL39676 (fl. — terat.); *Morrison s.n.,* 30.x.1906, Carnamah, CANB136625, PERTH (fl.); *Mueller s.n.,* -.xi.1862, Eyres Range, MEL39640, 39641 (fr.); *Mueller s.n.,* -.x.1877, Shark Bay, MEL39564 (fl., fr.); *Mueller s.n.,* -.xi.1877, Greenough River, MEL39675 (fl., fr.); *Orchard 1227,* 27.x.1968, Location 1105, Shire of Esperance, AD (fl.); *Orchard 1515,* 13.x.1968, Oldfield River at crossing of the Esperance-Ravensthorpe road, AD (fl.); *Orchard 1702,* 21.x.1968, northern end of Location 1163, Shire of Oldfield, AD (fl., fr.); *Preiss 2068,* 1837-1840, Swan River, G (Herb. Boiss.) (fl., fr.); *Pritzel 836,* -.x.1901, District Avon: in apertis arenosis, AD, M, NSW, P, PR (fl.); *Sewell s.n.,* 1889, Mt. Carol, MEL39662 (fr.); *Steedman 68,* -.xii.1929, Mt. Holland, PERTH (fr.); *van Dam 170,* 4.vii.1969, Wongan Hills, AD (fl., fr.); *Willis s.n.,* 12.ix.1947, Mundaring, MEL39574 (fl.). *SOUTH AUSTRALIA: Alcock 846,* 7.xi.1965, Section 17, Hd. Charleston, AD (fl., fr.); *Batt s.n.,* 1886, Eucla, MEL39588 (fl., fr.); *Blaylock 1248,* 26.iv.1969, Peella Rocks, Kyancutta, AK (fl., fr.); *Brummitt s.n.,* 11.xii.1892, Robertstown, AD96211067, AD96851094 (fr.); *Cleland s.n.,* 10.xi.1928, Wilpena Pound, AD968051012 (fl.); *Cleland s.n.,* 3.xi.1936, Whyalla, AD968051005 (fr.); *Cleland s.n.,* -.xi.1936, Iron Knob, AD968051015 (fl.); *Cleland s.n.,* 1.ix.1944, Whyalla Knob, AD968051027 (fl.); *Copley 1512,* 8.x.1967, Thurlga, AD (fl.); *Donner 2539,* 15.x.1967, 25 miles [40 km] E of Chilpuddie, AD (fl.); *Donner 3147,* 27.x.1968, ca 40 km north-north-east of Minnipa, AD (fl., fr.); *Eichler 20478,* 27.x.1968, 32 km north-north-east of Kimba, AD, AK (fl.); *Fagg 482,* 25.xi.1967, 8 km north-east of Darke Peak, AD (fr.); *Ising s.n.,* 2.ix.1935, Carapee Hill, AD966031993 (fl.); *Ising s.n.,* 13.ix.1938, Gawler Range, AD96803139 (fl.); *Jackson 1479,* 27.x.1968, ca 40 km north-north-east of Minnipa, AD (fl.); *Koch 182,* -.x.1901, Flinders Range, NSW (fl.); *Koch 282,* -.ix.1902, Flinders Range, P (fl.); *Orchard 1799,* 27.x.1968, ca 42 km north of Minnipa on road to Yardea, AD, AK (fl.); *Orchard 2148,* 15.viii.1969, Eyre Highway ca 13 km west of Kimba, AK (st.); *Orchard 2172,* 15.viii.1969, Yandinga Gorge, ca 50 km north of Minnipa, AD (st.); *Orchard 2248,* 26.ix.1969, Yandinga Gorge, AD (fl.); *Orchard 2328,* 28.ix.1969, ca 5 km east of intersection of Yardea, Nonning and Kingoonya road, AD, AK (fl.); *Orchard 2596,* 7.xi.1970, between Madges Hill and Edeowie Gorge, AD (fl.); *Orchard 3215,* 7.i.1971, ca 70 km east of Wirrulla, AD (st.); *Pulleine s.n.,* -.v.1931, Nonning, AD968051014 (st.); *Richards s.n.,* -.ix.1886, Middleback Ranges, AD96810020, MEL39597 (fl.); *Rogers 1814,* 4.xi.1961, Mount Whyalla, AD (fl., fr.); *Rogers 1815,* 9.xii.1969, Mount Whyalla, AD (fr.); *Rohrlach 5,* 15.xii.1958, Pinkawillinie, AD (fr.); *Specht & Carrodus 63,* 15.xi.1958, 12 miles [19 km] south-west of Nonning Homestead, AD (fl.); *Sullivan s.n.,* Gawler Ranges, MEL39541, 39553 (fl., fr.); *Symon 975,* 17.xi.1960, along the creek at Wilpena, ADW (fl.); *Tate s.n.,* Yudnamutana Mine, AD96810005 (fl.); *Whibley 1822,* 23.viii.1967, ca 55 km north of Cowell, AD (fr.).

When growing on sand in Western Australia, the flowers and fruits of *G. flavescens* are a distinctive pale creamy white and the rootstock is a simple taproot. When growing on rocky hillsides in Western

Australia and South Australia, the flowers and fruits are yellow and the rootstock becomes branched at the apex, the branches creeping on the surface of the soil or rocks for up to 10 cm.

Despite the widely disjunct distribution, no differences, other than those influenced by substrate and rainfall mentioned above, can be discerned between the South Australian and Western Australian populations that would warrant their recognition as distinct taxa.

Loudonia flavescens was described in a letter from Drummond to Hooker which was published by Hooker in the London Journal of Botany. Drummond did not cite any specimens in his letter, and a search by Mr J. Carrick in 1970 failed to locate any material in K or BM which bore the name *Loudonia flavescens*. Apparently the only extant Drummond collections which are annotated with this name are two in MEL, MEL39531 (*Drummond 73*) and MEL39532 (*Drummond 74*).) Of these only the former bears fruit (the other is sterile) and has therefore been chosen as lectotype. Specimens in G (herb. Boiss.), LE and P (in part) labelled *Drummond 73*, 1843, Swan River, are probably duplicates of the lectotype. However, of the two sheets in P so labelled, only the one with the handwritten label is a possible iso-lectotype. The other, with a printed label, is *G. aureum* var. *aureum*.

In its flower and fruit morphology and relatively robust habit, this species shows some similarity with species of *Haloragodendron*, particularly *H. racemosum*, and may provide a link between the two genera. Within *Glischrocaryon*, *G. flavescens* is probably most closely related to *G. aureum*, but is easily distinguished in flower by its navicular (rather than hooded) petals, and in its fruits by the narrower wings.

2. **Glischrocaryon aureum** (Lindl.) Orchard (Figs. 6, 185-187)

Glischrocaryon aureum (Lindl.) Orchard, Taxon 19 (1970) 823

Loudonia aurea Lindley, Sketch Veg. Swan R. Col. (1840) 42. [Typus: none cited. Sheet in CGE consisting of 3 collections with annotations by Lindley. Lectotypus (Orchard): "*Mrs. Molloy*. Vasse River on the South West coast of New Holland. 1839." CGE (fl.)!] Walp., Rep. 2 (1843) 100; Nees, in Lehm., Pl. Preiss. 1 (1844) 153; Walp., Ann. 1 (1848) 293, 4 (1858) 683; F. v. M., Linnaea 25 (1853) 385; Loudon et al. (ed.), Loud. Encycl. Pl. (1855) 1354; Benth., Fl. Aust. 2 (1864) 472; Hereman (ed.), Paxton's Bot. Dict. (1868) 344; F. v. M., Fragm. 8 (1874) 162, 11 (1878) 20; Tate, Trans. R. Soc. S. Aust. 3 (1880) 64; F. v. M., Census 1 (1882) 49; Tepper, Trans. R. Soc. S. Aust. 9 (1887) 115 ('*Loudonio aurea*'); Cleland, Trans. R. Soc. S. Aust. 10 (1888) 78; F. v. M., Sec. Census 1 (1889) 85; Tate, Fl. S. Aust. (1890) 100, 233; Petersen, Pflfam. 3 (1893) 228, 231-2; F. v. M. & Tate, Trans. R. Soc. S. Aust. 16 (1896) 352; Koch, Trans. R. Soc. S. Aust. 22 (1898) 111; Moore, J. Linn. Soc. (Bot.) 34 (1899) 190; Schindler, Bot. Jb. 34 Beibl. 77 (1904) 8; Schindler, Pflrch 23 (1905) 17; Gardner, Wildfls W. Aust. (1926) 120; Black, Fl. S. Aust. (1926) 429, 2 ed. (1952) 641; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 464; Praglowski, Grana 10 (1970) 164.

FIGS.: Lindley, Sketch Veg. Swan R. Col. (1840) 43, fig. 1, 2; Lindley, Veg. Kingd. (1853) fig. CCCCLXXXII; Baill., Nat. Hist. Pl. 6 (1880) figs. 462-464; Petersen, Pflam. 3 (1893) fig. 98E, F, 101B; Gardner, Wildfls W. Aust. (1926) 119; Black, Fl. S. Aust. 2 ed. (1962) fig. 870; Blackall & Grieve, 3 (1965) pl. 20; Praglowski, Grana 10 (1970) pl. 1 (a-c).

Glabrous perennial herb 25-75 (-100) cm tall; perennial rootstock woody, branched or unbranched with rough brown cortex, up to 1 cm diam. at apex; stems annual, smooth, green to brown, pithy, 1-4 mm diam. at base, sparsely branched. Leaves dimorphic, alternate, sessile, the juvenile leaves narrower than mature leaves. Mature leaves 1-6 cm long, 0.2-1.5 cm wide, midrib indistinct.

Inflorescence an umbelliform series of compound dichasia. Flowering stem terminated by a compound dichasium of 7-31 flowers with 1-5 compound dichasia on the stem immediately below. The flowers of the ultimate dichasial branches may or may not be functional. 1-6 lateral inflorescences are borne in the axils of the upper leaves.

Flowers yellow, 4-merous. Sepals 4, yellow, deltoid, 0.6-0.9 mm long, 1.0-1.3 mm wide, smooth. Petals 4, yellow, hooded, keeled, very shortly unguiculate, 2-4 mm long, 0.8-1.1 mm wide (keel to margin). Stamens 8, filaments 0.2-0.4 mm long; anthers 4-celled, yellow, oblong, 1-3 mm long, 0.4-0.5 mm wide, connective produced into a short apiculum, the antipetalous anthers ca 0.2-0.5 mm shorter than the antisepalous anthers. Styles 4, yellow, 0.8-1.0 mm long, stigmas yellow, capitate, very shortly fimbriate. Ovary yellow, pyriform, 2-3 mm long, 1.5-3.0 mm wide (incl. wings), pericarp unswollen, 4 wings; ovules 4, in a single locule with central columella.

Fruit yellow or reddish, on pedicel up to 4 mm long, ovoid-obovoid, 7.5-11.5 mm long, 4.5-7.5 mm wide (incl. wings), 4-winged (wings 2.0-3.5 mm wide); sepals persistent, erect, forming circum-stylar tube, free part deltoid, 0.5-0.7 mm long, 1.0-2.2 mm wide; pericarp usually not swollen, or if swollen, then wings still distinct; single pendulous seed occupies entire locule.

var. **aureum**

Glabrous perennial herb, (30-) 40-75 (-100) cm tall, perennial rootstock woody, with rough, brown cortication, ca 1 cm diam. at top, sparsely branched. Stems annual, smooth, green, pithy, 2-4 mm

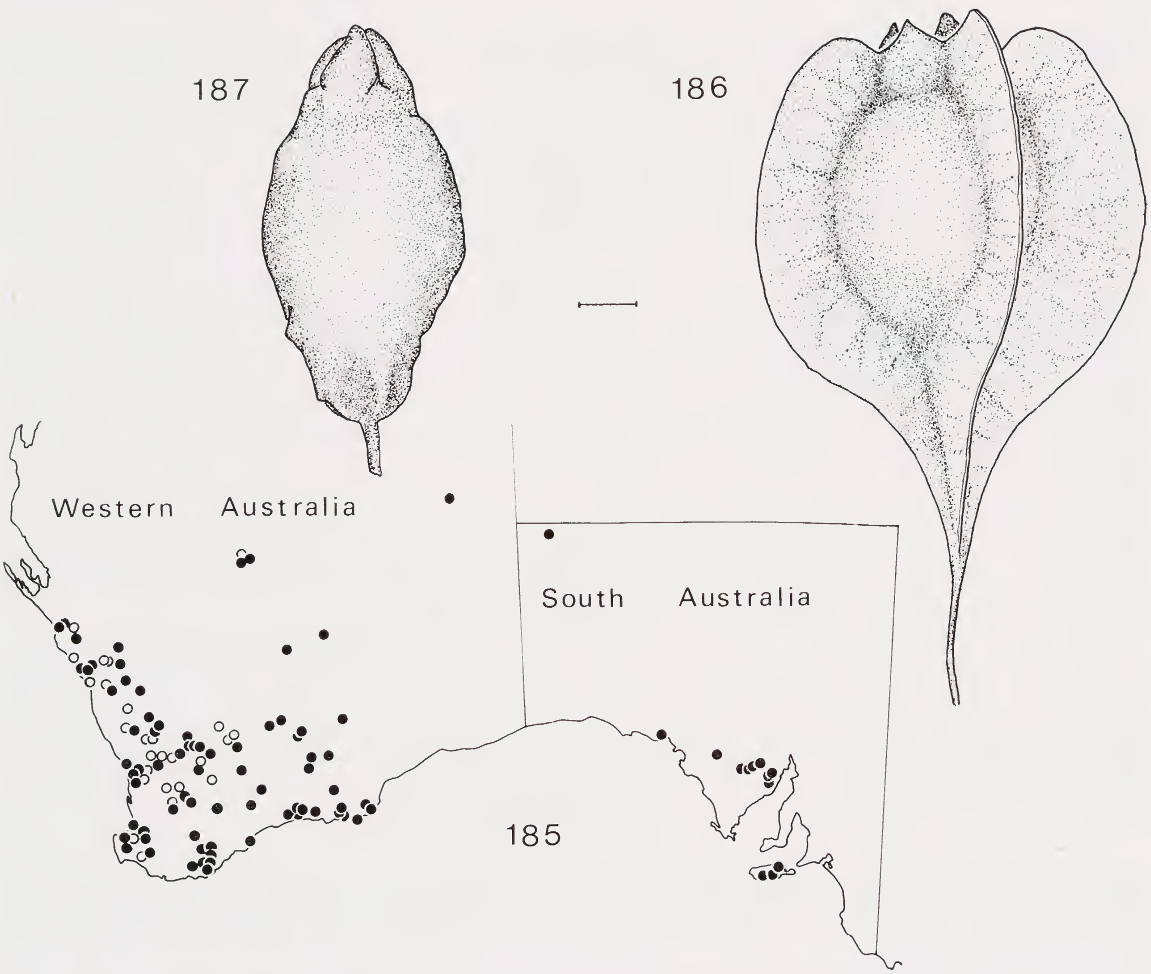
diam. at base, sparsely branched, leaves dimorphic, alternate. Juvenile leaves flattened, linear-lanceolate, 1.0-2.0 cm long, 0.1-0.15 cm wide, sessile, acute at tip. Adult leaves oblanceolate, (1.7-) 3.0-6.0 cm long, 0.2-0.5 cm wide, sessile, tapering gradually to base, apex acute, midrib indistinct, not raised or channelled, lateral veins very indistinct, ± parallel to midrib.

Inflorescence a terminal, 15-31-flowered compound dichasium with 1 (-2?) compound dichasia borne on the stem immediately below. The flowers of the ultimate branches may be non-functional. Several of the dichasia may be reduced to monochasia, but not in any regular sequence. Lateral inflorescences similar to the terminal inflorescence occur in the axils of the upper 5-6 leaves.

Flowers yellow, 4-merous. Sepals 4, deltoid, 0.7-0.9 mm long, 1.0-1.2 mm wide, smooth, margin ± entire. Petals 4, yellow, hooded, very shortly unguiculate, (2.5-) 3.0-4.0 mm long, 0.9-1.1 mm wide. Stamens 8, filaments yellow, 0.2-0.3 mm long; anthers yellow, 4-celled, oblong, 2.3-2.5 mm long, 0.35-0.5 mm wide, connective produced into a very short apiculum, the antipetalous anthers 0.2-0.3 mm shorter than antisepalous ones. Styles 4, 0.9 mm long. Ovary yellow, pyriform, 2.0-3.0 mm long (incl. wings), 1.6-2.3 mm wide, 4-winged, pericarp not swollen, on slender pedicel 1.5 mm long, wings membranous, decurrent in pedicel and sepals; ovules 4, in a single locule with central columella.

Fruit yellow, sometimes reddish, on pedicel ca 4 mm long, obovoid, 7.5-8.5 mm long, 4.5-6.0 mm wide, pericarp usually not swollen, 4-winged, the wings membranous with radiating dichotomising veins, no intramarginal vein, 2.0-2.5 mm wide, decurrent in pedicel and sepals; sepals persistent, decurrent with wings, forming circumstylar tube, free part deltoid, 0.5-0.7 (-1.0) mm long, 1.7-2.2 mm wide; 1 locule, 1 seed.

Distribution: This taxon is confined to a coastal strip of Western Australia, extending from the Darling Range near Perth to the vicinity of Shark Bay (Fig. 185).



Figs. 185-187. *Glischrocaryon aureum*. 185. Distribution (○ = var. *aureum*, ● = var. *angustifolium*). 186, 187. Fruits of *G. aureum* var. *angustifolium*; 186. normal winged form (from *Orchard 1703*). 187. aberrant wingless form (from *Orchard 1701*). Scale represents 1 mm (figs. 186, 187).

ECOLOGY: *G. aureum* var. *aureum* ranges over a variety of soils, mainly sandy, with an annual rainfall of between 35 and 100 cm. Collectors' notes include "Edge of sand plain" (*Ashby 81*); "On hillside of shallow soil over sandstone" (*Belcher 243*); "White sand" (*Galbraith WA527*); "Granitic soil, with *Cas.* [*Casuarina*] *huegeliana*" (*Gardner 2792*); "Sand. Low heath with *Melaleuca cordata*" (*Green 593*); "Lateritic ridge south of big granite outcrop" (*Heinsohn 91*) and "Spinifex sandplain (burn)" (*Speck 827*). Flowers August to October, fruits September to December.

SPECIMENS EXAMINED:

WESTERN AUSTRALIA: Adams s.n., 1889, interior of Western Australia, MEL39592 (fl., fr.); *Adams s.n.*, 1891, Mangowine, MEL39596 (fl.); *Anon. s.n.*, Kings Pk., UWA524 (fl.); *Anon. s.n.*, Oct., Bullsbrook Rd., UWA525 (fl.); *Aplin 119, 165*, 10.ix.1958, 8-10 miles [13-16 km] east of Calingiri along Wongan Hills Road, PERTH (fl.); *Aplin 766*, -.x.1960, Reserve — 17 miles [27 km] East of Pingelly, PERTH (fl., fr.); *Ashby 81*, 6.ix.1946, Moora, AD, PERTH (fl.); *Bailey s.n*, Sept., 8 miles [13 km] east Meckering, PERTH (fr.); *Bailey 124*, Muntadgin, CANB (fr.); *Bailey 721*. Muntadgin, CANB (fl., fr.); *Baird s.n.*, Yandanooka, UWA522 (fl.); *Belcher & Belcher 243*, 8.x.1967, Ringa-Clackline Road about 1 mile [2 km] south of Ringa, MEL, PERTH (fl.); *Cleland s.n.*, -.ix.1908, Cunderdin, NSW98842 (fl.); *Cronin s.n.*, 1889, Sources of Blackwood River, MEL39593, 39664 (fr.); *Drummond s.n.*, 1839, Swan River, CGE (fl., young fr.) — syntype, & P (fl.) — isosyntype of *L. aurea*; *Drummond 73*, 1843, Swan River, P (fr.); *Drummond 409*, Swan River, W (fl., young fr.); *Eaton s.n.*, 1888, 1889, sources of the Swan River, MEL39585, 39570 (fl., fr.); *Eaton s.n.*, 1893, Youndegin, MEL39668 (fr.); *Filson 8583*, 6.ix.1966, North-West Coastal Highway, 7 miles [11 km] North of the Murchison River Bridge, MEL (fl., fr.); *Fitzgerald s.n.*, -.x.1900, Darling Range, NSW98844 (fl., fr.); *Forrest s.n.*, 1881, between Swan River & King Georges Sound, MEL39602 (fl.); *Forrest s.n.*, 1889, near Lake Deborah, MEL 39589 (fl., fr.); *Galbraith WA527*, 17.viii.1964, Mullewa-Wilroy Road, AD (fl., fr.); *Gardner 2792*, 1.x.1931, Moorine Rock, PERTH (fl.); *Gardner 13616*, 18.x.1961, 10 km east of Bendering, PERTH (fr.); *Gittins 1564*, -.viii.1967, 44 miles [70 km] south of Wannoo Roadhouse, NSW (fl.); *Gray s.n.*, 1873, Champion Bay, MEL39599 (fl., fr.); *Green 593*, 3.xi.1956, 2 miles [3 km] N. of Yerecoin, PERTH (fr.); *Grieve s.n.*, -.viii.1947, Northampton Dist., UWA526 (fl.); *Guerin s.n.*, 1871, Champions Bay, MEL39549 (fr.); *Hamilton s.n.*, 1902, W.A., NSW98835 (fl., fr.); *Heinsohn 91*, 13.xi.1966, Tuttanning Reserve, 17 miles [27 km] E. of Pingelly, PERTH (fr.); *Helms s.n.*, -.ix.1898, Darling Range, NSW98849 (fl.); *Helms s.n.*, -.ix.1898, Darlington, NSW132637 (fl.); *Helms s.n.*, 15.ix.1898, Mullewa, NSW132636 (fl., fr.); *Helms s.n.*, -.xii.1898, Kelmscott, M (fl.); *Helms s.n.*, 14.x.1899, Swan View, NSW132638 (fl., fr.); *Jessup s.n.*, -.ix.1947, between Geraldton and Northampton, MEL39573 (fl., fr.); *Koch 2953*, 9.xi.1923, Merredin, NSW (fl., fr.); *Lea s.n.*, Swan River, Perth (fl.); *Loneragan 67.028*, 8.x.1967, 23 miles [37 km] SW of Eneabba, Eneabba-Three Springs Rd., UWA (fr.); *Luff & Birrell 12*, 4.x.1963, ca 192 km from Perth on Great Northern Highway, AD (fr.); *Maiden s.n.*, -.ix.1909, Welshpool-Kalamunda, NSW103172 (fl.); *Maiden s.n.*, -.ix.1909, Tammin, AD96921174 ex NSW (fl.); *Maiden s.n.*, -.x.1909, Southern Cross, AD96921188 (fl.); *Mangles s.n.*, Swan River, CGE (fl.) — syntype of *L. aurea*; *Meebold 605*, -.x.1928, Swan River, M (fl.); *Meebold 6608*, -.xii.1929, Watheroo, M (fr.); *Merrall s.n.*, 1888, E. sources of Swan River, MEL39577 (fr.); *Molloy s.n.*, 1839, Vasse River, on the South West coast of New Holland, CGE (fl.) — lectotype of *L. aurea*; *Monch s.n.*, -.xi.1946, south of Geraldton, PERTH (fr.); *Morrison s.n.*, 5.x.1903, Wongan Hills, CANB136623 (fl., fr.); *Morrison s.n.*, 5.xii.1903, Swanview, Darling Range, CANB 136624 (fr.); *Mueller s.n.*, -.xi.1877, Upper Swan River, MEL39660 (fr.); *Preiss 2067*, 8.ix.1839, east of Mount Bakewell, LE (st.); *Preiss 2068*, -.x.1839, Canning River, Perth, P (fl.); *Preiss 2068*, 14.x.1839, prope urbiculam Guildford et ad fluvium Canning, LE (fl., fr.); *Preiss 2068*, 19.x.1839, l.c., P (herb. Bunge) (fl., fr.); *Preiss 2068*, 1843, Swan River, G (herb. DC.), MEL39547, 39636, P (fl.); *Roark s.n.*, 13.xi.1949, Darlington, AD96905108, UWA (terat. fl., fr.); *Salasoo 4162*, 24.ix.1970, Perth to Wanneroo, NSW (fl.); *Salasoo 4321*, 26.ix.1970, Lesmurdie, NSW (fl.); *Salasoo 4348*, 27.ix.1970, 2 miles [3 km] SW of Cunderdin, NSW (fl., fr.); *Sewell s.n.*, between the Rivers Murchison and Arwin, MEL39550 (fl., fr.); *Sewell s.n.*, 1886, 1889, Mt. Caroline, MEL39598, 39578 (fl., fr.); *Sewell 5*, 1885, Swan River, MEL (fl.); *Sonster 552*, 13.x.1946, Perth, NSW (fl.); *Speck s.n.*, 6.ix.1949, Murchison River, UWA527 (fr.); *Speck s.n.*, 22.ix.1951, Mimegarra-Mt. Misery, UWA518 (fl.); *Speck 827*, 15.ix.1957, 30 miles [48 km] N. of Wiluna, CANB (fl.); *Stone 431*, -.viii.1947, Muntadgin, CANB (fl.); *Vachell s.n.*, -.xii.1903, Kellerberrin, NSW98837 (fr.); *Vauzetti s.n.*, -.x.1925, Marchagee, PERTH (fr.); *Wells s.n.*, 50 miles [80 km] east of York, MEL39670 (fl., fr.); *White 5285*, 5.xi.1927, Narrogin, BRI (fr.); *Wilson 3846*, 2.xi.1965. 10 km N. of Badgingarra, PERTH (fl., fr.)

The choice of a lectotype is necessary as there are 3 distinct collections on the type sheet in CGE. All three collections belong to the same taxon. The collection by Mrs Molloy consisting of 2 stems each bearing an inflorescence is here chosen as lectotype, as one of the stems closely resembles the illustration accompanying Lindley's description. Stearn (1952) mentions the other 2 collectors (Mangles and Drummond) as providing material for Lindley, but does not mention Molloy. Erickson (1969) states (p. 28) that Mrs Molloy was a collector for Mangles, and that some of her collections were seen by Lindley before publication of his account of the Swan River plants.

All three collections in CGE bear small tubercular swellings between the wings of the fruit, differing in this respect from nearly all other collections placed in var. *aureum*. A swollen pericarp is a common occurrence in var. *angustifolium*, suggesting that these three collections may be the result of introgression. One other recent collection (*Aplin 119*) also has calluses between the wings and smaller flowers than usual. *Aplin 165* from the same locality is typical for var. *aureum* in all respects.

Nees (1844), in describing *L. aurea β angustifolia* cited two Preiss numbers (three localities) under the species description, i.e., by implication, under var. *aurea*. Preiss collections under these numbers

(2067 and 2068) exist in P (general collection and herb. Bunge), G (herb. Boiss. and herb. DC.), LE, M and MEL. Upon examination of these collections it was found that they were heterogeneous. Their correct determinations are as set out below.

Preiss 2067	G (herb. DC.)	*G. aureum* var. *angustifolium*
	LE	*G. aureum* var. *aureum*
	MEL39633 p.p.	*G. aureum* var. *aureum*
	P (herb. Bunge)	*G. aureum* var. *angustifolium*
Preiss 2068	P	*G. aureum* var. *aureum*
	P (herb. Bunge)	*G. aureum* var. *aureum*
	LE	*G. aureum* var. *aureum*
	G (herb. DC.)	*G. aureum* var. *aureum*
	G (herb. Boiss.) p.p.	*G. aureum* var. *angustifolium*
	G (herb. Boiss.) p.p.	*G. flavescens*
	M	*G. aureum* var. *angustifolium*
	MEL39547	
	MEL39633 p.p.	*G. aureum* var. *aureum*
	MEL39636	

The relationships of this taxon are, on the one hand, with var. *angustifolium*, and on the other, with *G. flavescens*.

var. **angustifolium** (Nees) Orchard, comb. et stat. nov.

Loudonia aurea β angustifolia Nees, in Lehm., Pl. Preiss 1 (1844) 159 [Typus: "In glareosis sterilibus districtus Hay m. Novembri a. 1840. Herb. Preiss. No. 2079." Holotypus: unknown. Isotypus: *Preiss 2079*, 7.xi.1840, In glareosis sterilibus districtus Hay, LE!, P (Herb. Bunge)! (fl.)].

Extremely variable glabrous perennial herb 25-65 cm tall; perennial woody rootstock usually consisting only of a simple taproot, sometimes branched at top, clothed in rough brown bark, up to 1 cm in diam. at top; stems annual, smooth, green-brown, pithy, 1.0-2.0 (-3.5) mm diam. at base, sparsely branched, and then mainly near base. Leaves dimorphic, alternate. Juvenile leaves ± terete, 6-7 mm long, 0.5 mm wide, channelled above, crowded, sessile, ± mucronate. Mature leaves flattened, linear to linear-lanceolate, (0.8-) 1.2-3.0 (-4.0) cm long, 1.0-1.5 mm wide, sessile, acute, veins indistinct.

Inflorescence a terminal compound dichasium Flowering stem terminated by a 7-20-flowered compound dichasium with 4-5 compound dichasia of 7-27 flowers borne alternately on the stem immediately below. The flowers of the ultimate branches may or may not be functional. Some dichasia reduced to monochasia, and compound dichasia often unevenly branched. Auxiliary flowers occur sporadically. One or two lateral inflorescences occur in the axils of the upper leaves. Primary bracts fleshy, leaf-like, oblanceolate-obovate, adnate at base to subtended peduncle, length of free part 0.8-1.2 cm, width 0.35-0.4 cm, tapering towards base, apex obtuse. Secondary bracts as for primary bracts, 0.3-0.6 cm long, 0.1-0.2 cm wide. Tertiary, etc. bracts membranous, deciduous at or about anthesis, up to 1.5 mm long (Fig. 6).

Flowers yellow, 4-merous. Sepals 4, yellow, deltoid, 0.6-0.8 mm long, 0.9-1.3 mm wide, smooth, margin slightly irregular, decurrent in wings of ovary. Petals 4, yellow, hooded (rarely ± navicular), keeled, very shortly unguiculate, 2.0-3.0 (-3.5) mm long, 0.8-0.9 mm wide (keel to margin). Stamens 8, yellow, filaments 0.3-0.4 mm long; anthers oblong, (0.8-) 1.3-2.6 (-3.2) mm long, 0.4-0.5 mm wide, 4-celled, ± apiculate, antipetalous anthers ca 0.5 mm shorter than antisepalous ones. Styles 4, yellow, 0.8-1.0 mm long, stigmas capitate, very shortly fimbriate, yellow. Ovary yellow, pyriform, 1.7-2.8 (-4.0) mm long, 1.3-2.0 (-3.0) mm wide; 4-winged, the wings decurrent in the sepals and pedicel, 1 locule, 4 pendulous ovules.

Fruit yellow or reddish, ovoid-obovoid, 7.5-11.5 mm long, 4.5-7.5 mm wide, 4-winged, the wings membranous, venation radiating, dichotomous, with no marginal vein, (1.5-) 2.0-3.5 mm wide, decurrent in pedicel and sepals; sepals forming a circum-stylar tube, their free tips broad-deltoid, 0.5-0.7 mm long, 1.0-2.0 mm wide; endocarp slightly woody, exocarp swollen or not swollen, but never reducing the wings to ribs as in *G. roei*. Single seed occupies entire locule (Figs. 186, 187).

Distribution: This taxon is extremely widespread in south-western Western Australia, in the region south of Shark Bay and west of Kalgoorlie. It is also known from northern Eyre Peninsula and Kangaroo Island in South Australia (Fig. 185).

Ecology: *G. aureum* var. *angustifolium* grows over a very wide range of soils and climatic conditions. Collectors' notes include "Dry gravel" (*Andrews s.n.*), "Heath with scattered mallees on laterite" (*Briggs s.n.*), "Spinifex" (*Brockway s.n.*), "Coastal Dunes" (*Eichler 20107*), "In Jarrah (*Eucalyptus marginata*)

country" (*Fairall 345*), "In white sandy loam over laterite" (*George 6997*), "Shallow pale yellow sand over laterite. Assoc. *Banksia attenuata* and *Actino-strobus*" (*Green 750*), "on granite outcrop" (*McLean s.n.*), "grey sand on roadside" (*Rayner s.n.*), "spinifex sandplain" (*Speck 827*), "Rich sandplain soil. Only very low shrubs, few acacia, many creepers" (*Went 139*). Flowers are present from (July-) August to November (-December), and fruits from (September-) October to December (-May).

Specimens examined:

WESTERN AUSTRALIA: Alexander 1243, -.x.1915, Waddouring, PERTH (fr.); *Allan 138,* 4.xi.1969, Harrowsmith, PERTH (fl., fr.); *Andrews s.n.,* 10.vii.1901, Childow's Well, PERTH (fl.); *Aplin 1127,* -.x.1961, 5 m [8 km] south of Yanchep, PERTH (fl.) — voucher for Alkaloid Survey sub nom. *L. aurea*; *Aplin 1216,* 6.xi.1961, Glen Eagle-Jarrahdale Road, PERTH (fl., fr.) — voucher for Alkaloid Survey sub nom. *L. aurea*; *Aplin 1824,* 8.ix.1962, Jimberlana Hill, 5 miles [8 km] NE of Norseman, PERTH (fl.) — voucher for Alkaloid Survey sub nom. *L. aurea,* pollen sent to Palyn. Lab. Stockholm; *Bailey 666,* -.ix.1945, Muntadgin, PERTH (fr.), CANB (fl., fr.); *Bailey 721,* -.ix.1945, Muntadgin, PERTH (fl., fr.); *Bradshaw & Lipfert 1659,* Oct.-Nov. 1920, Stirling Ranges, PERTH (fl., fr.); *Briggs s.n.,* 30.ix.1960, 57 miles [91 km] W of Coolgardie, NSW98834 (fl.); *Brockway s.n.,* 14.x.1947, North East of Wiluna, CANB26596 (fl., fr.); *Brockway 4,* -.xii.1943, betw. No. 7 Pumping Station & Woolgangie, PERTH (fr.); *Brooker s.n.,* 1884, 1885, Israelite Bay, MEL39557. 39595 (fl., fr.); *Brookes s.n.,* -.ix.1915, Israelite Bay, NSW98863 (fr.); *Burns 1052,* 23.x.1966, 80 miles [128 km] N of Geraldton on North West Coastal Highway, PERTH (fr.); *Carey s.n.,* 1877, West end of Great Bight, MEL39600 (fl.); *Cashmore 133,* 27.ix.1939, Boolardy Station, PERTH (fl.); *Clarke s.n.,* Hampden, MEL39537 (fl., fr.); *Cleland s.n.,* Perth, NSW98829 (fl.); *Cleland s.n.,* -.x.1907, Geraldton, NSW98841 (fl.); *Dempster s.n.,* 1871, between Esperance Bay and Russell Range, MEL39548 (fl., fr.); *Diels & Pritzel 185,* -.xi.1900, Swan District: Subiaco, PERTH (fl., fr.); *Donner 1370,* 29.ix.1965, ca 11 km west of Bullabulling, AD (fl.); *Donner 2967,* 10.x.1968, ca 27 km north of Young River crossing on Ravensthorpe-Esperance road, AD (fl., fr.); *Donner 3046,* 16.x.1968, Location 1110, Esperance District, AD, PERTH (fl., fr.); *Drummond 190,* Swan River, LE (fl., fr.); *Eaton s.n.,* 1892, Youndigna, MEL39576 (fl.); *Eichler 20050,* 30.ix.1968, ca 34 km north of Widgiemooltha, AD (fl., fr.); *Eichler 20107,* 2.x.1968, Duke of Orleans Bay, AD (fl.); *Eichler 20241 bis,* 15.x.1968, Location 1153, Shire of Esperance, AD (fr.); *Eichler 20257,* 15.x.1968, Location 1159, Shire of Esperance, AD (fl., fr.); *Eichler 20282,* 16.x.1968, Location 1117, Shire of Esperance, AD (fl., fr.); Eichler 20386, 21.x.1968, Location 1163, Shire of Oldfield, AD (fl., fr.); *Eichler 20405,* 21.x.1968, Location 1131, Shire of Oldfield, AD (fl., fr.); *Eichler 20412,* 23.x.1968, near foot of Mt. Ragged, AD (fl., fr.); *Fairall 345,* 6.x.1962, 42 mile peg Dale Road, PERTH (fl.); *Forrest s.n.,* 1881, Upper Swan River, MEL39563 (fr.); *Forrest s.n.,* -.xi.1881, near Stirling Range, MEL 39579 (fl.); *Forrest s.n.,* -.iii.1910, Busselton, NSW103171 (fl., fr.); *Forrest s.n.,* -.viii.1910, Busselton, AD96921171 (fl.); *Gascoyne s. n.(p.p.),* 2.xi.1891, 85 miles [136 km] NE from Esperance Bay, NSW98846 (fl.); *Geological Survey 170,* 1916, East of Laverton, PERTH (fl.); *George 6003,* 10.xi.1963, 15 miles [24 km] W of Cundeelee Mission, PERTH, AD (fr.); *George 6997,* 29.x.1965, 23 miles [37 km] S of Jerramungup, along Devils Creek road, PERTH (fl., fr.); *Gittens 1621,* -.viii.1967, Murchison House Stn., NSW, PERTH (fl., fr.); *Goadby 274,* -.x.1900, Mt. Barker, NSW (fr.); *Goadby 275,* -.xii.1900, King George's Sound, NSW (fr.); *Goadby B2032,* -.x.1900, Mt. Barker, PERTH (fl., fr.); *Goadby B2033,* -.xii.1900, Kalgan River, King George's Sound, PERTH (fr.); *Goodall KL2423,* 3.xii.1965, 15 km SE of Cundeelee Mission, UWA (fl., fr.); *Gray s.n.,* Greenough Flats, MEL39538 (fl., fr.); *Green 750,* 3.xi.1956, Piawaning, UWA (fr.); *Green 795,* 3.xi.1956, 6 miles [10 km] S of Ballidu, UWA (fl., fr.); *Grieve s.n.,* 14.ii.1959, Tammin, UWA508 (fr.); *Grieve s.n.,* 26.v.1959, ± 115 mile peg beyond Tammin, UWA509 (fr.); *Grover s.n.,* 1889, north of King George's Sound, MEL39582 (fr.); *Helms s.n.,* 17.ix.1891, Victoria Desert Camp 54, AD96803272 (fl.), NSW98846 (p.p.), 98850 (fr.); *Helms s.n.,* 2.xi.1891, Near Fraser Range, NSW28843 (fl.); *Helms s.n.,* 12.xi.1891, Gnarlbine, AD96906011, 96803279, MEL39534, NSW98826, 98828 (fl., fr.); *Helms s.n.,* -.xii.1898, Mt. Barker, M, NSW98839 (fl.); *Herbert s.n.,* -.xi.1920, Merredin, PERTH (fr.); *Humphries s.n.,* 29.ix.1950, Bunjil, UWA521 (fl., fr.); *Ising s.n.,* -.x.1938, Albany, AD96803160 (fr.); *Johnson 5095,* 23.x.1958, 80 miles [128 km] W Giles, CANB, PERTH (fr.); *Kelso s.n.,* -.viii.1902, Raeside Soak, PERTH (fl.); *King & Lefroy s.n.,* 1889, Yilgarn near Mt. Moore, MEL39671 (fr.); *Knight s.n.*. Porongerup, MEL39567 (fl.); *Koch 1914,* -.x.1940, Lowden, P (fl., fr.); *Kuchel 1667,* 11.ix.1964, ca 50 km east of Esperance, AD (fl.); *Kuchel 1832,* 15.ix.1964, ca 65 km west of Daniell, AD (fl.); *Loneragan 8,* 20.xii.1961, Mersca Lake near Wilgarup, UWA (fr.); *Lullfitz L2024,* 21.xii.1962, 186 mile peg Morawa Road, PERTH (fl); *Lullfitz L3843,* 25.xi.1964, Lake Cronin, PERTH (fr.); *Maiden s.n.,* -.x.1909, Pindar, AD96921170 (fl., fr.); *Maiden s.n.,* -.xi.1909, King George's Sound, AD96921167 (fl., fr.); *Maxwell s.n.,* towards the Great Bight, MEL39542 (fl., fr.); *Maxwell s.n.,* Eyres and Phillips Ranges, MEL39555 (fr.); *Maxwell s.n.,* East River, Stokes Inlet, MEL39569 (fl.); *Maxwell s.n.,* 1875, near Cape Arid, MEL39572 (fr.); *McLean s.n.,* 6.v.1934, Gutha, UWA507 (fl., fr.); *Meebold 1625,* -.xi.1928, Farm Etna, Broomhill, M (fl.); *Meebold 7012,* -.xii.1929, Toolbroonup, M (fl., fr.); *Meebold 7428,* -.xii.1929, Williams, M (fr.); *Merrall s.n.,* 1889, Mt. Moore, MEL39672, 39590 (fl., fr.); *Merrall s.n.,* 1890, Parkers Range, MEL39575 (fl.); *Morrison s.n.,* 4.xi.1898, Subiaco, P, BRI079878 (fl., fr.); *Morrison s.n.,* 7.xi.1899, Smiths Mill, Darling Ranges, CANB136622, PERTH (fl., fr.); *Morrison s.n.,* 21.x.1902, Ellens Peak, Stirling Ranges, PERTH (fl., fr.); *Morrison 16040,* 12.i.1906, Kamballie, Coolgardie District, PERTH (fl.); *Morrison s.n.,* 17.xi.1909, Claremont, AD96344276, BRI079877, CANB136621, PERTH (fl., fr.); *Morrison & Serventy s.n.,* 20.ix.1948, Murchison River, PERTH (fr.); *Mueller s.n.,* -.x.1867, north of Stirling Range, MEL39568 (fl.); *Newbey 1486,* 27.ix.1964, 1 mile [2 km] East of Lake Grace, PERTH (fl., fr.); *Oldfield s.n.,* Kalgan River, MEL39551 (fl.); *Orchard 1067,* 18.ix.1968, near Howick Hill, AD (fl.); *Orchard 1120,* 21.ix.1968, Location 251, near Howick Hill, AD (fl., fr.); *Orchard 1173, 1174,* 25.ix.1968, Location 900, Shire of Oldfield, AD (fl.); *Orchard 1221, 1222, 1224,* 27.ix.1968, Location 1105, Shire of Esperance, AD (fl.); *Orchard 1359,* 4.x.1968, Wittenoom Hills, Shire of Neridup, AD (fl., fr.); *Orchard 1399,* 8.x.1968, Lort River, near crossing of the Esperance-Ravensthorpe road, AD (fl.); *Orchard 1521,* 13.x.1968, Oldfield River at crossing of the Esperance-Ravensthorpe road, AD (fl., fr.); *Orchard 1576, 1577,* 16.x.1968. Location 1110, Shire of Esperance, AD (fl., fr.); *Orchard 1703,* 21.x.1968, Location 1163, Shire of Oldfield, AD, PERTH (fl., fr.); *Petticrew s.n.,* -.viii.1915, Wickepin, PERTH (fr.);

Preiss 2067, 8.ix.1839, In calculosis ad latus orientale montis Bakewell (York), P (herb. Bunge) (st.); *Preiss 2067,* 1843, in Col. Swan River, G (herb. DC) (fl.); *Preiss 2068 p.p.,* 1837-1840, Swan River, G (herb. Boiss.), M (fl., fr.); *Preiss 2079,* 7.xi.1840, In glareosis sterilibus districtus Hay, LE, P (herb. Bunge) (fl.) — isotype of *L. aurea β angustifolia*; *Pritzel 8,* -.xi.1900, District Swan, AD, M, NSW, P, PR (fl., fr.); *Pulleine s.n.,* -.xii.1917, Balingup, AD96921186, NSW103169 (fr.); *Rayner s.n.,* 23.vi.1957, Hines Hill, UWA503 (fr.); *Roark s.n.,* 1.xii.1949, Darlington, UWA515, UWA519 (fr.); *Roach s.n.,* -.x.1968, Pithara, AD96844244 (fr.); *Royce 2262,* 15.x.1947, Boyanup, PERTH (fl.); *Royce 2990,* 29.x.1948, Dorradup, on Nannup-Karridale road, PERTH (fl., fr.); *Saffrey 1439,* 7.x.1970, NW corner of Fitzgerald River Reserve, PERTH (fl., fr.); *Salasoo 312,* 22.x.1949, Northam-Perth Highway, 4-6 miles [6-10 km] from Northam, NSW98847 (fl.); *Sayer & Carlson s.n.,* bet. Hampton Plain and York, MEL39591 (fr.); *Sewell s.n.,* 1889, Mt. Caroline near Mt. Stirling, MEL39667 (fl.); *Sewell s.n.,* 1890, Spring Valley, MEL39669 (fl., fr.); *Speck s.n.,* 23.ix.1951, Kings — Three Springs, UWA516 (fr.); *Speck 827,* 15.ix.1957, 30 miles [48 km] north of Wiluna, PERTH (fl.); *Speck 912,* 25.ix.1953, 46-63 mile tanks, UWA (fl.); *Steedman s.n.,* -.xii.1929, Lake Hope, PERTH (fr.); *Stewart s.n.,* NE Wiluna, PERTH (fl., fr.); *Tate s.n.,* Sandhills south of George Gill Range, AD96810039 (fr.); *Taylor s.n.,* 1887, near the Thomas River, MEL 39603 (fl., fr.); *Victor s.n.,* -.x.1898, Murchison District, PERTH (fl., fr.); *Warburton s.n.,* 1870, Upper Hay River, MEL39544 (fl.); *Webb s.n.,* 1884, Bremer River, MEL39601 (fl.); *Webb s.n.,* 1888, King George's Sound, MEL39587 (fl.); *Webb 76,* 1880, King George's Sound, MEL (fr.); *Went 139,* 9.ix.1962, halfway between Geraldton and Mullewa, PERTH (fl.); *Wilson 5720,* 10.x.1966, 90 mile tank, ca 80 km W of Kumarl, PERTH (fl., fr.); *Wilson 6450,* 13.iii.1968, 14 km S of Koorda, PERTH (fr.); *Wilson 6475,* 3 km N of Wubin, PERTH (fl., fr.); *Wilson 6918,* 8.viii.1968, near Lake Chidnup, PERTH (fl., fr.). *SOUTH AUSTRALIA: Cleland s.n.,* 7.xi.1955, ca 25 km east of Kimba, AD968051016 (fl., fr.); *Cleland s.n.,* 15.xi.1955, between Kimba and Iron Knob, AD968051018 (fl., fr.); *Hockley s.n.,* 10.i.1962, lower part of Middleback Ra., ADW24880 (fr.); *Ising s.n.,* 30.xii.1922, MacGillivray, Kangaroo Island, AD96803137 (fr.); *Latz 931.* 1.xi.1970, 52 miles [83 km] NE of Mt. Davies Camp, AD (fl., fr.); *Lothian 4251,* 11.vi.1968, Hd. of Pinkawillinie, AD (fr.); *Orchard 1779,* 26.x.1968, ca 32 km north of Minnipa along track to Yardea, AD (fl., fr.); *Orchard 2929, 2934,* 29.xii.1970, foot of Iron Duke, AD (fl., fr.); *Orchard 3217,* 8.i.1971, Eyre Highway ca 40 km west of Kimba, AD, AK (fr.); *Orchard 3218,* 8.i.1971, Eyre Highway ca 10 km south-west of Kimba, AD, AK (fr.); *Orchard 3223,* 8.i.1971, Eyre Highway ca 26 km north-east of Kimba, AD (fl., fr.); *Reid s.n.,* 3.x.1966, N of Koonibba, ADW38038 (fl.); *Richards s.n.* (p.p.), -.ix.1886, Middle Back Ranges, AD96810020 (fr.); *Rogers s.n.,* 12.xi.1908, Kingscote, Kangaroo Island, NSW98855 (fr.); *Rohrlach 325,* 17.iv.1959, County Buxton, Pinkawillinie, AD (fl., fr.); *Schomburgk s.n.,* Central S. Austr., AD96906013 (fr.); *Tepper 78,* 4.iii.1886, Between head of South West River and Karatta at Circular Lagoon, Kangaroo Island, AD (fl., fr.).

G. aureum var. *angustifolium* is intermediate in many characters between *G. aureum* var. *aureum* and *G. roei*. In addition its range encompasses that of the other two taxa and spreads beyond. These facts, as well as its wide variability and weedy habit, suggest that *G. aureum* var. *angustifolium* may have arisen by hybridisation of *G. roei* and *G. aureum* var. *aureum*.

Some collections from Kangaroo Island have trimerous flowers and fruits, while others have tetramerous (= *G. aureum*) or bimerous (= *G. behrii*) flowers and fruits. It seems likely that the trimerous plants are the product of introgression between *G. aureum* var. *angustifolium* and *G. behrii*. This phenomenon apparently does not occur on northern Eyre Peninsula, where the two species also grow side by side.

3. **Glischrocaryon roei** Endl. (Figs. 188, 189)

Glischrocaryon roei Endlicher, Ann. Wien Mus. 2 (1838) 209 [Typus: "Crescit in Novae Hollandiae austro-occidentalis interioribus (Roe)." Holotypus: "Roe, N.H.A.O.M." W! (fr.).]; Endl. & Fenzl, Nov. Stirp. Dec. 9 (1839) 78; Orchard, Taxon 19 (1970) 823.

Loudonia roei (Endl.) Schldl., Linnaea 20 (1847) 648; Walp., Ann. 1 (1848) 293; Benth., Fl. Aust. 2 (1864) 472; F. v. M., Fragm. 8 (1874) 162; F. v. M., Census 1 (1882) 49; F. v. M., Sec. Census 1 (1889) 85; Schindl., Bot. Jb. 34 Beibl. 77 (1904) 7 ('*L. Rhoei*'); Schindler, Pflrch 23 (1905) 18; Black, Fl. S. Aust. (1926) 429, 2 ed. (1952) 641; Gardner, Enum. (1931) 99; Gardner, Wildfls W. Aust. (1959) 120; Eichler, Suppl. Black's Fl. S. Aust. (1965) 245; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 464.

Figs.: Blackall & Grieve, W. Aust. Wildfls 3 (1965) 464.

Perennial herb 30-40 cm tall, glabrous; taproot perennial, ± shortly branched at top, clothed in brown corky bark; stems erect, annual, smooth, green, slender, 1-2 mm diam., well developed pith, branching mainly at base. Apparently no distinct juvenile leaves. Mature leaves alternate, sessile, ± fleshy, linear, 1.0 cm long, 0.5 mm wide, acute at apex, slightly concave on upper surface, veins not apparent.

Inflorescence a series of terminal compound dichasia. Flowering stem terminated by 4-8 flowers either in a compound dichasium or the final branches monochasial, all the flowers functional, or those of the final branches abortive. About 3 compound dichasia or monochasia of 2-6 flowers are borne alternately on the stem immediately below the terminal inflorescence. The whole inflorescence is compact and capitate with no lateral inflorescences from lower on the stem as in other species. Primary bracts ± fleshy, leaf-like, oblanceolate, 5-7 mm long, 1-2 mm wide, tapering towards base, apex acute, adnate at base to the subtended peduncle. Secondary bracts membranous, lanceolate-oblanceolate, 2-3 mm long, 1 mm wide, acute. Tertiary, etc., bracts membranous, extremely small, deciduous at or about anthesis.

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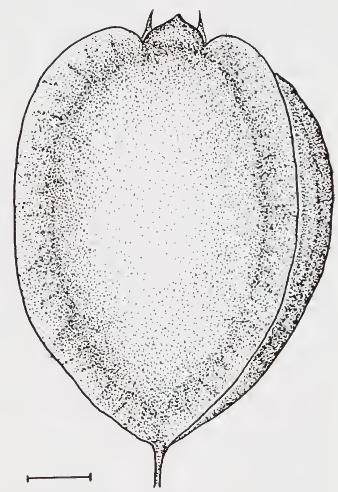


Figs. 188, 189. *Glischrocaryon roei.* 188. Distribution. 189. Fruit (from *Orchard 1520*). Scale represents 1 mm.

Flowers yellow, 4-merous. Sepals 4, deltoid, 0.3-0.6 mm long, 0.8-1.0 mm wide, smooth, margins entire. Petals 4, yellow, navicular, keeled, 2.2-2.4 mm long, 0.7-0.9 mm wide, keel to margin. Stamens 8, filaments 0.4 mm long; anthers yellow, narrow-oblong, 1.7-2.0 mm long, 0.4-0.6 mm wide, ± non-apiculate, 4-locular, antipetalous anthers ca 0.4 mm shorter than antisepalous anthers. Styles 4, yellow, 1.2-1.4 mm long, ovoid-capitate yellow stigmas. Ovary swollen, obovoid to obpyriform, 2.0 mm long, 1.5 mm wide, 4-angled or ribbed, ribs 0.15 mm wide; 1 locule with 4 pendulous ovules.

Fruit yellow, ovoid, 6.0-7.5 mm long, 4.5-5.0 mm wide, 4 longitudinal ribs or narrow wings up to 0.5 mm wide, sepals persistent 0.5-0.6 mm long, 0.7-1.2 mm wide, ± not decussate in wings, ± not forming circumstylar tube, exocarp swollen, fibrous, endocarp slightly woody; single seed occupies entire locule. (Fig. 189).

Distribution: *G. roei* is confined to a narrow coastal strip of south-western Western Australia between Stokes Inlet (75 km west of Esperance) and Albany (Fig. 188).

Ecology: In the Esperance district, *G. roei* grows on light sandy soils, usually in disturbed habitats, especially along roadsides (*Orchard,* various collections). *Beard 2275* is recorded as growing "on rocky slopes". Flowers are present in October, fruits from October to November.

Specimens examined:

WESTERN AUSTRALIA: Anon s.n., Fitzgerald River, MEL39659 (fr.); *Beard 2275,* 2.xi.1962, Mount Desmond (Ravensthorpe), PERTH (fr.); *Drummond 190, 5th coll* Swan River to Cape Riche, CGE (fr.); *Eichler 20241,* 15.x.1968, Location 1153, Shire of Esperance, AD (f .); *Eichler 20256,* 15.x.1968, Location 1159, Shire of Esperance, AD (fl., fr.); *Eichler 20284,* 16.x.1968, Loc tion 1117, Shire of Esperance, AD (fl., fr.); *Maiden s.n.,* -.xi.1909, Kalgan Plains, NSW98831 (fr.); *Maxwell s.n.,* S.W. Australia, MEL39539 (fl., fr.); *Meebold 1554,* -.xi.1928, Nornalup, M (fr.); *Meebold 7203,* -.xii.1929, Stirling Range, M (fr.); *Orchard 1520,* 13.x.1968, Oldfield River at crossing of the Esperance-Ravensthorpe road, AD (fr.); *Orchard 1526,* 14.x.1968, Location 1100-1151, Shire of Esperance, AD (fl., fr.); *Orchard 1630,* 18.x.1968, Location 37-38, Shire of Esperance, AD (fl., fr.); *Orchard 1701, 1704, 1721,* 21.x.1968, Location 1163, Shire of Esperance, AD, PERTH (fl., fr.); *Roe s.n.,* N.H.A.O.M., W (fr.) — holotype of *Glischrocaryon roei*; *Webb s.n.,* 1885, Salt River, MEL39581 (fl.).

G. roei most closely resembles *G. aureum* var. *angustifolium*, and is possibly one parent of that (postulated) hybrid taxon (see under discussion of generic relationships).

4. **Glischrocaryon behrii** (Schldl.) Orchard (Figs. 7-9, 190, 191)

Glischrocaryon behrii (Schlechtendal) Orchard, Taxon 19 (1970) 823

Loudonia behrii Schldl., Linnaea 20 (1847) 648 [Typus: "Auf unfruchtbarem Sandboden gesellschaftlich. November. Die blumen von reinem leuchtenden Gelb". Holotypus: *Anon 166,* Nov. Sandplain b. Tonanda, MEL39635 ex herb. Sonder (fl., fr.)! Isotypus: *Behr 166,* 1848, Sud Australie, G (herb. Boissier)! (fl.)]; F. v. M., Linnaea 25 (1853) 385; Benth., Fl. Aust. 2 (1864) 472; F. v. M., Fragm. 8 (1874) 162; Tate, Trans. R. Soc.

S. Aust. 3 (1880) 64; Tepper, Trans. R. Soc. S. Aust. 3 (1880) 176; F. v. M,. Census 1 (1882) 49; Tate, Trans. R. Soc. S .Aust. 4 (1882) 106, 6 (1883) 138, 156; F. v. M., Key Syst. Vict. Pl. 2 (1885) 22, 1 (1887-8) 259; F. v. M., Sec. Census 1 (1889) 85; Tate, Trans. R. Soc. S. Aust. 12 (1889) 65, 95; Tate, Fl. S. Aust. (1890) 100, 233; Moore, Hdbk. Fl. N.S. Wales (1893) 184; Petersen, Pflfam. 3 (1893) 232; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 5; Schindler, Pflrch 23 (1905) 19; Dixon, Pl. N.S. Wales (1906) 129; Maiden & Betche, Census N.S. Wales Pl. (1916) 158; Black, Fl. S. Aust. 3 (1926) 429; Ewart, Fl. Vict. (1930) 879; Black, Fl. S. Aust. 2 ed. 3 (1952) 641; Praglowski, Grana 10 (1970) 164; Willis, Hdbk. Pl. Vict. 2 (1972) 467.

FIGS.: Petersen, Pflfam. 3 (1893) fig. 101C; Schindler, Pflrch 23 (1905) fig. 4C, C'; Black, Fl. S. Aust. 2 ed. (1952) fig. 869; Praglowski, Grana 10 (1970) pl. 1 (d-e).

Small erect perennial herb, glabrous, 30-50 cm tall, rootstock woody, perennial, with a well-developed taproot, stems erect, annual, numerous, arising from very short lateral branches of rootstock. Stems glabrous, smooth, sparsely branched, except at base and within the inflorescence, often ± leafless.

Leaves alternate, often deciduous at an early stage, variable, terete to linear or narrow-lanceolate, (0.5-) 1.5-2.5 cm long, 0.1-0.2 (-0.3) cm wide, fleshy, minutely mucronate, sessile, margin entire, veins and midrib not apparent.

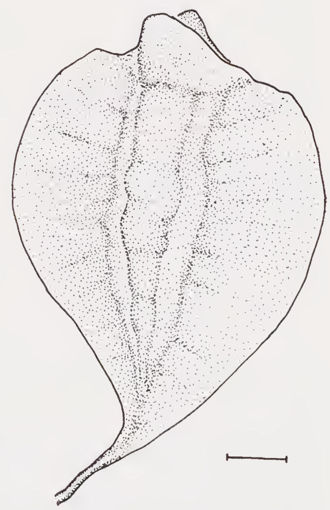
Inflorescence terminal, pseudo-umbelliform. Floral axis terminated by a compound dichasium of 15-31 flowers, with 4-5 alternately arranged dichasia of 7-63 flowers below. All flowers except those of the ultimate branches are functional. The peduncles of the lower compound dichasia tend to be relatively long and adnate to the basal part of the subtending primary bract, resulting in the bract apparently being borne some distance along the branch it subtends. This also applies to bracts of higher orders. Lateral inflorescences similar to, but usually of a lesser degree of branching than the terminal one, borne irregularly in the axils of some of the upper leaves. Primary bracts leaflike, green, fleshy, sometimes absent in upper part of inflorescence, free part narrow-lanceolate 0.7-0.9 cm long, 0.1-0.2 cm wide; secondary bracts similar, 0.1-0.2 cm long, 0.05 cm wide, often deciduous at about anthesis; tertiary bracts and those of higher order less than 1 mm long (Figs. 7-9).

Flowers yellow, 2-merous, borne on filamentous pedicels 0.1-0.3 cm long, on short thick peduncles ca 0.05 cm long. Sepals 2, yellow, deltoid, 0.7-1.0 mm long, 1.0-1.2 mm wide, smooth, decurrent in wings of ovary. Petals 2, yellow, ± hooded, unguiculate, (2.6-) 3.5-4.0 mm long, 0.8-1.0 mm wide (keel to margin). Stamens 4, filaments yellow, 0.5 mm long; anthers yellow, linear-oblong, 1.5-2.7 mm long, 0.5-0.6 mm wide, 4-locular, antisepalous stamens slightly larger than antipetalous ones, connective usually produced into a very short apiculum at top of anther. Styles 2, antipetalous, cylindrical, 0.5-0.7 mm long, with capitate stigmas. Ovary inferior, yellow, compressed pyriform due to 2 longitudinal anti-petalous wings, 3.0-3.5 mm long, 2.0-2.5 mm wide, wings decurrent with sepals and pedicel, alternating with antisepalous longitudinal saccate swellings; ovary unilocular with a median columella, 4 pendulous ovules, of which only 2 are functional.

Fruit yellow, occasionally reddish, on pedicel 2-5 mm long, 2-winged, obovate, 8.5-10.0 mm long, 7.5-9.6 mm wide, wings with radiating dichotomous veins, no marginal vein, fused with sepals at apex to form circumstylar cavity, decurrent in pedicel at base, saccate longitudinal callus opposite sepals, free portion of sepals broad deltoid, 0.7-1.3 mm long, 2.5-2.8 mm wide, 1 seed, occupying entire locule (Fig. 191).

190

191



Figs. 190, 191. *Glischrocaryon behrii*. 190. Distribution. 191. Fruit (from *Orchard 1805*). Scale represents 1 mm.

Distribution: This species is confined to western Victoria, south-eastern South Australia as far north as Adelaide and including the "Murray Mallee", Yorke and Eyre Peninsulas, and Kangaroo Island. *G.* (*Loudonia*) *behrii* was recorded also for south-western New South Wales by Moore (1893) and Dixon (1906), but this assertion is supported by only a single recent New South Wales collection from Gundagai-Yass. (Fig. 190).

Ecology: *G. behrii* grows in mallee communities, usually on ± deep sand and often in disturbed ground. Collectors' notes include "open disturbed roadside" (*Anway 474*); "grey white sand, sand-dune. *Eucalyptus incrassata* association" (*Barker 644*); "roadside mallee scrub, red clay soil" (*Dredge 2A*); "a common perennial of white sand dunes" (*Kraehenbuehl 2050*); "yellow sand dune" (*Orchard 1808*); "heathy scrub on lateritic sand ridge" (*Schodde 538*); "burnt ground, gregarious, 8-12 in. [20-30 cm] tufts" (*Tate AD 96810048*); "sandy burnt scrub" (*Tepper 1815*); "deep sand, low fertility Mallee scrub (*Moore 4635*). Flowers are present from late August to October, and fruits from October to February.

Common name: "Golden Pennants" (Willis, 1972).

Specimens examined:

NEW SOUTH WALES: Clyne s.n., 1969, Hume Highway, Gundagai/Yass, NSW132765 (fr.). *SOUTH AUSTRALIA: Alcock s.n.*, -.x.1963, Hundred of Mortlock, AD (fr.); *Alcock C36A*, 30.x.1964, Hundred of Cummins, AD (fl., fr.) — pollen sent to Palyn. Lab. Stockholm; *Alcock C97*, 20.xii.1964, Hundred of Wanilla, AD (fr.); *Alcock 1549*, 29.x.1967, ca 3 km west of Mt. Verran, AD (fl., fr.); *Alcock 2183*, 6.x.1968, Hincks National Park, AD (fl.); *Alcock 2487*, 13.x.1968, Hincks National Park, AD (fl.); *Amtsberg 44*, 20.xi.1966, near Minlaton, AD (fr.); *Anway 474*, 7.x.1965, 47 miles [75 km] east of Kyancutta, AD, MEL, NSW, PERTH (fl., fr.); *Anon s.n.*, Port Lincoln, AD96906016 (fl., fr.); *A. Ashby 753*, 31.x.1940, Coonalpyn, AD (fr.); *E. Ashby 851*, -.x.1905, Middle River, Kangaroo Island, NSW (fl.); *E. & K. Ashby s.n.*, 30.x.1940, 14.xi.1940, between Tailem Bend and Bordertown, AD96803153 (fr.); *Barker 644*, 14.x.1968, Hundred of Ramsay, AD (fl.); *Barker 693*, 3.xi.1968, ca 5 km south of Monarto South, AD (fr.); *Barker 705*, 3.xi.1968, ca 2 km east of Goolwa-Ashbourne road, AD (fl., fr.); *Behr s.n.*, 1849, in locis sterilibus fruticetis obtectis. Nov. Holl. austr., MEL39652 (fl.); *Behr 166*, 1848, Sud Australie, G (herb. Boissier) (fl.) — isotype of *Loudonia behrii; Beythein s.n.* 1890, Moonta, MEL39646 (fr.); *Beckler 26*, -.x.1825, Lake Koorong [= Coorong], M (fr.); *Blaylock 1549*, 10.x.1970, ca 15 km ESE of Minlaton, AK (fl.); *Browne 20*, 110, Port Lincoln, MEL39649 (fl., fr.); *Clarke & Ising s.n.*, 10.x.1936, Kangaroo Flat, AD966031994 (fl., fr.); *Cleland s.n.*, 16.x.1920, Monarto South, AD96805997 (fl.); *Cleland s.n.*, 8.xi.1924, Kinchina, AD966032595 (fr.); *Cleland s.n.*, 16.xi.1924, Rocky River, Kangaroo Island, AD968051020 (fr.); *Cleland s.n.*, 27.i.1933, Mt. Scrub, Waitpinga, AD968051023 (fr.); *Cleland s.n.*, 25.i.1940, Cape Borda Road, Kangaroo Island, AD968051026 (fr.); *Cleland s.n.*, 25.xi.1945, Breakneck River, Kangaroo Island, AD968051024 (fr.); *Cleland s.n.*, 5.ii.1946, Breakneck River, AD968051021 (fr.); *Cleland s.n.*, 6.ii.1946, west of Breakneck River, AD968051019 (fr.); *Crisp 28*, 22.xi.1970, Cox's Scrub Nat. Park, AD (fl., fr.); *Crocker s.n.*, 23.x.1943, W. of Murray Bridge, CANB11789 (fl.); *Czornij 79*, 27.x.1966, 5 km south of Ashbourne, AD (fl., fr.); *Donner 179*, 24.viii.1961, Shipley Hill, AD, AK (fl.); *Dredge 2A*, 15.xi.1968, 21 miles [34 km] NW of Coulta, AD, AK (fr.); *Eichler 15086*, 4.x.1958, Chauncey's Line — Monarto South, AD, AK (fl., fr.); *Eichler 18462*, 21.xii.1965, ca 3 km east of Sou'West River, AD, CHR (fr.); *Eichler 19318*, 6.x.1967, ca 8 km north-east of Bascombe Well Homestead, AD (fl.); *Fagg 492*, 26.xi.1967, ca 12 km south of Kimba, AD (fr.); *Gill 162*, 30.ix.1890, Yorke's Peninsula, MEL (fl.); *Grivell 26*, 8.vi.1969, ca 5 km south of Monarto South, AD (fr.); *Hunt 205*, 14.x.1961, between Western Flat and Bordertown, AD (fl.); *Hunt 2140*, 19.ix.1964, ca 40 km south-west of Keith, AD (fl.); *Hunt 3067*, 10.x.1969, Santa Cruz Scrub, Waitpinga, AD (fl., fr.); *Ising s.n.*, 13.x.1916, Bordertown, AD966032046 (fl., fr.); *Ising s.n.*, -.x.1929, Monarto South, AD966031952 (fl., fr.); *Ising s.n.*, -.x.1929, Sandalwood, AD966031961 (fl.); *Ising s.n.*, 16.x.1930, Kinchina, AD966031915 (fr.); *Ising s.n.*, -.x.1932, Yeelanna, AD96803125 (fr.); *Ising s.n.*, -.x.1932, Wynarka School, AD966031810 (fl.); *Ising s.n.*, 29.viii.1935, Arno Bay, AD966031722 (fl.); *Ising s.n.*, 30.viii.1935, Rudall, AD966032025 (fl., fr.); *Ising s.n.*, 7.xi.1937, Cookes Plains, AD966032305 (fr.); *Jackson 297*, 28.xii.1959, Rocky River, AD, CHR (fr.); *Jackson 318*, 6.x.1963, Muston turnoff on Kingscote-Penneshaw road, AD (fl.); *Kaspiew s.n.*, 12.xi.1956, Millicent, M (fl., fr.); *Kraehenbuehl 1062*, 13.x.1963, western part of Archibald Makin Reserve, AD (fl.); *Kraehenbuehl 2050*, 8.x.1966, Hambidge National Park, AD (fl.); *Kuchel 1300*, 22.x.1963, Hundred of Blesing, AD (fr.); *Kuchel 1412*, 23.x.1963, Hundred of Tooligie, AD (fr.); *Lothian 982*, 9.x.1961, 10 miles [16 km] north of Stansbury, AD (fl.); *Lower s.n.*, 20.xi.1952, Arno Bay, ADW8992 (fr.); *Menzel s.n.*, -.x.1896, Goolwa, NSW98858 (fl., fr.); *Mueller s.n.*, -.x.1851, Pine forest Gawler town, MEL39631 p.p. (fl.); *Mueller s.n.*, -.xi.1851, Mount Barker, MEL39631 p.p. (fr.); *Orchard 1805*, 3.xi.1968, ca 5½ km south of Monarto South, AD (fr.); *Orchard 1808*, 3.xi.1968, ca 9 km south east of Finnis, AD, AK (fr.); *Orchard 2148*, 15.viii.1969, 13 km west of Kimba, AD (fl.); *Orchard 2342*, 28.ix.1969, Eyre Highway ca 30 km west of Kimba, AD (fl., fr.); *Orchard 2586*, 11.x.1970, ca 10 km south-east of Minlaton, AD, AK (fl.); *Orchard 2635*, 4.xii.1970, Dukes Highway ca 32 km north-west of Bordertown, AD (fr.); *Orchard 2996*, 30.xii.1970, ca 13 km west of Ungarra, AD (fr.); *Orchard 3219*, 8.i.1971, Eyre Highway ca 10 km south-west of Kimba, AD (fr.); *Osborn s.n.*, 28.xi.1923, Flinders Chase, AD96810053 (fl., fr.); *Pearson s.n.*, -.xi.1930, between Kingscote & American River, AD96803132 (fr.); *Phillips s.n.*, 22.ix.1965, 4 miles [6 km] N of Mt. Hope homestead, AD96919334 (fl.); *Robjohns s.n.*, 24.x.1967, Point Bolingbroke, AD96848094 (fl.); *Rogers s.n.*, -.ix.1908, Middle River — Western River, NSW98854 (fl.); *Rothe & Ising s.n.*, 24.x.1919, Monarto South, AD96803130 (fr.); *Schodde 538*, 20.xii.1957, ca 12 km east of Cape Borda, AD, CANB (fr.); *Schwartz s.n.*, 1890, Lower Murray Scrub, MEL39580 (fl.); *Sharrad s.n.*, 23.x.1959, 1 mile [2 km] south of Hall, AD96405270 (fl., fr.); *Sharrad 92*, 21.ix.1959, Malinong, AD (fl.); *Sharrad 360*, 3.xi.1959, 3 miles [5 km] west of Malinong, AD (fl.); *D. Smith 83*, -.xi.1955, 5 miles [8 km] west of Yeelanna, MEL (fl.); *T. Smith 795*, 31.x.1967, ca 6 km south of Monarto South, AD (fl., fr.); *Specht s.n.*, -.xi.1953, ca 16 km north-north-east of Keith, AD96514078 (fl., fr.); *Specht 2294*, 13.x.1960, Flora & Fauna Reserve, Hundred of Billiatt, AD (fl., fr.); *Specht 2361*, 14.x.1960, Flora & Fauna Reserve, Hundred of Peebinga, AD (fl., fr.); *Specht 2435*, 8.xi.1960, Flora & Fauna Reserve,

Hundred of Hambidge, AD (fr.); *Specht 2612, 2613,* 11.xi.1960, Flora & Fauna Reserve, Hundred of Hincks, AD (fr.); *Spooner 942,* 27.ix.1970, Finnis Scrub, AD (fl.); *Symon 6125,* 8.x.1968, Hincks National Park, ADW (fl.); *Tate s.n.,* Finnis Station, AD96810004 (fr.); *Tate s.n.,* American River, AD96810016 (fr.); *Tate s.n.,* 29.ix.1880, Muloowortie Road, AD96810064 (fl., fr.); *Tate s.n.,* 2.x.1880, east of Wellington, AD96810031 (fl.); *Tate s.n.,* 4.iii.1886, between Hundred of Cygnet & Karatta, AD96810048 (fr.); *Tepper s.n.,* 27.x.1887, Nuriootpa, AD96811091 (fl., fr.); *Tepper s.n.,* 31.x.1889, Murray Bridge, AD96811092 (fr.); *Tepper 87, 88,* 10 & 17.xi.1886, Karatta, MEL (fr.); *Tepper 404,* 1884, Hundred of Freeling, AD (fr.); *Tepper 1815,* 8.xi.1886, Karatta to Birchman's Lagoon, AD (fr.); *Tillbrook 1057,* 13.x.1919, Naturi, AD (fl., fr.); *Warren 6,* 17.v.1969, Meribah-Peebinga road, AD (fr.); *Wheeler 1138,* 13.x.1968, Hincks National Park, AD (fl , fr.); *Whibley 21,* 15.xi.1956, Nangkita road near Mount Compass, AD (fl., fr.); *Wilson 383,* 11.x.1958, Boston Point, AD (fl., fr.); *Wilson 726,* 5.xi.1958, Kelly Hill, AD, AK (fl.); *Wilson 1005,* 2.xii.1958, Chauncey's Line, AD (fr.); *Wilson 1424,* 22.xi.1959, Ashville, AD (fr.); *Wilson 2086,* 29.viii.1961, ca 65 km north of Bordertown, AD (fl.); *Womersley s.n.,* 3.i.1944, east of Flinders Chase, AD96810019 (fr.). *VICTORIA: Ackland 86,* 1.x.1963, 30.6 miles [49 km] N. of Yanac, BRI, MEL, UPS (fl., fr.); *Aston 159,* 3.xi.1958, ca 1 mile [2 km] SW of Lake Hattah, MEL (fl., fr.); *Aston 428,* 20.x.1959, 15 miles [24 km] NNE of Bendigo, MEL (fl., fr.); *Aston 981,* 28.ix.1963, ca 20 miles [32 km] S. of Nhill, MEL (fl.); *Bissett s.n.,* 1870, Eaglehawk, MEL39620, 39628 (fl.); *Briggs 2876,* 20 x.1969, Eastern Lookout, Wyperfeld National Park, NSW (fr.); *Constable 5226,* 23.x.1964, 18 miles [29 km] NNE of Bendigo, NSW (fl., fr.); *D'Alton s.n.,* Nhill, MEL39625 (fl.); *D'Alton 13,* Mount Arapiles, MEL39621 (fr.); *D'Alton 26,* 1903, Dimboola, NSW (fl.); *Davis s.n.,* 1888, 1890, Wimmera, MEL39630, 39624 (fl., fr.); *Duncan 6139,* anno 1862, Victoria, P (fr.); *Eckert s.n.,* 1891, Wimmera, MEL39626 (fl., fr.); *French s.n.,* -.ix.1887, NW of Lake Albacutya, MEL39618 (fl.); *Holland 3076,* (W15), -.x.1965, Wyperfeld National Park, CANB (fl.); *Meebold 6245,* Mildura, M (fl.); *Moore 4635,* 19.x.1966, between Tempy and Ouyen, CANB (fl., fr.); *Morris 1564,* 15.x.1926, Mittyack, NSW (fr.); *Morris 1564,* 15.x.1926, Mittijack, BRI (st.); *Mueller s.n.,* Victoria, LE (fr.); *Mueller s.n.,* Murray River, MEL39654 (fl., fr.); *Mueller s.n.,* Australia felix, P (fr.); *Muir 909,* 20 x.1959, about 6 miles [9 km] north of Bagshot, MEL (fl.); *Musgrave 6,* -.x.1948, 9 miles [14 km] S of Kiata, NSW (fr.); *Reader 11,* 29.x.1892, near Dimboola, MEL (fr.); *Seebeck s.n.,* 3.x.1965, Hattah Lakes National Park, MEL39605 (fl.); *Thacker s.n.,* -.x.1897, Wimmera, NSW98859 (fr.); *Walters s.n.,* -.xi.1887, Wimmera, MEL39623 (fr.); *Walters s.n.,* -.x.1891, Wimmera District, BRI079881 (st.).

Two collections of Alcock (2183 & 2487) both from Hincks National Park have distinctly larger leaves and flowers than usual. Another collection made at the same time and in the same locality *(Wheeler 1138)* is within the normal size range. The differences are probably caused by exceptional local conditions and are not considered significant.

The apiculum of the anthers is usually moderately well developed in western specimens, but often poorly developed or absent in eastern plants. The change appears to be clinal.

The specimen nominated as holotype (MEL39635) is from Sonder's herbarium and bears a label "166. Loudonia behrii Schldl." on which is stamped "scripsit Schlechtendal". As no other specimen which could be the holotype is known to the present author, this sheet, annotated by Schlechtendal, seems the most likely candidate.

This species closely matches *G. aureum* var. *angustifolium* in leaf and general fruit morphology, and in overall habit. The ranges of the two taxa overlap on Eyre Peninsula and Kangaroo Island. In the latter place, plants with trimerous flowers and fruits are relatively frequently encountered, suggesting possible hybridisation between the two species.

Genus **MEZIELLA**

Meziella Schindler, Pflrch 23 (1905) 60 [Type species: *M. trifida* (Nees) Schindler, l.c., p. 61] Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 463, 472.

Glabrous creeping perennial herb, stems rooting at nodes, leaves alternate, trifid, lobes $\pm$ terete, with a short tooth in the angles between them.

Inflorescence an indeterminate spike of single flowers in the axils of alternate, leaflike, primary bracts. Flowers 4-merous on short pedicels. Sepals 4, narrow-deltoid, midrib weak or lacking. Petals 4, navicular or $\pm$ planar, not hooded. Stamens 4, antisepalous, filaments short, anthers broad linear. Styles 4, stigmas capitate. Ovary obconical, 4-ribbed, 4-locular, 4 ovules. Fruit unknown.

A genus of one species, *M. trifida,* which is known only from the type collection.

1. **Meziella trifida** (Nees) Schindl.

Meziella trifida (Nees) Schindler, Pflrch 23 (1905) 61; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 472.

Gonocarpus ['*Goniocarpus*'] *trifidus* Nees, in Lehm., Pl. Preiss, 1 (1844) 159 [Typus: "In turfosis humidis ad lacum haud procul ab oppidulo Albany (Plantagenet) m. Octobri 1840. Herb. Preiss. No. 2401" Holotypus: *Preiss 2401,* 11.x.1840, In turfosis humidis ad lacum haud procul ab oppidulo Albany (Plantagenet), LE (fl.) [herb. Nees ab Esenbäk"]! Isotypus: *L. Preiss s.n.,* 11.x.1940, In turfosis humidis ad lacum haud longe ab oppidulo "Albany" (Plantagenet), MEL1003795 (st.)!] Gray, Bot. U.S. Expl. Exped. 1 (1854) 628.

Haloragis trifida (Nees) Walp., Rep. 5 (1846) 672; F. v. M., Trans. R. Soc. Vict. 24 (1888) 137.

FIGS.: Schindler, Pflrch 23 (1905) fig. 18; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 463, 472.

Glabrous herb, up to 3 cm tall, stems creeping, arcuate ascending or decumbent; leaves alternate, crowded, pseudo-verticillate, trifid, 1.0 cm long, 2.0-5.0 mm wide, sessile, lobes erect, terete, ± 3 mm long, 0.2 mm wide, entire, apex acute, with a tiny tooth in angle between lobes, all veins obscure.

Inflorescence an indeterminate (?) spike of single flowers in the axils of leaflike primary bracts. Lateral inflorescences apparently absent. Primary bracts leaflike, trifid, indistinguishable from upper leaves in size and shape. Secondary bracts ('bracteoles') narrow-ovate, 1.4 mm long, acuminate, entire. Flowers 4-merous, on pedicels 0.2 mm long. Sepals 4, narrow-deltoid, 1.3-2.0 mm long, 0.15 mm wide, thickly subsetose at apex, weakly midribbed with a median basal callus. Petals 4, cream, navicular to planar, not hooded, apex acute and tricuspidate,non-unguiculate, 0.8-1.7 mm long, 0.1-0.3 mm wide. Stamens 4, antisepalous, filaments 0.2 mm long; anthers oblong, 1.0 mm long, 0.25 mm wide. Styles 4, oblong, convergent, 0.2 mm long, stigmas capitate. Ovary obovoid, 0.3 mm long, 0.4-0.5 mm wide, 4-ribbed opposite petals, 4-locular with 4 ovules.

Fruits not available.

DISTRIBUTION: This species is known only from near Albany in south-western Western Australia.

ECOLOGY: *M. trifida* apparently favours the swampy margins of lakes. Flowering occurs in October.

SPECIMENS EXAMINED:

WESTERN AUSTRALIA: Preiss 2401, 11.x.1840, near Albany, LE, MEL (fl.) — type of *G. trifidus*.

Although the citation of the locality is slightly different in the LE and MEL specimens ("haud procul . . ." and "haud longe . . ." respectively) there is little doubt that they belong to the same collection.

The species is known only from the type collection and this is extremely fragmentary, consisting only of short pieces of stem, leaves, and one incomplete spike of young buds. For this reason, the above description is based largely on that of Schindler (1905), who apparently saw much better material. More collections, particularly fruiting specimens, are urgently needed, but it is possible (or even probable) that the species is extinct.

GENUS **GONOCARPUS**

Gonocarpus Thunberg, Nov. Gen. 3 (1783) 55 et Fl. Jap. (1784) 5 (non *Gonocarpus* Ham., Prod. Pl. Ind. Occ. 39 (1825) n.v. = *Combretum* L. fide Shaw (1966)) [Type species: *G. micranthus* Thunb., l.c., p. 69] Labill., Pl. Nov. Holl. 1 (1804) 39, t. 53.

Gonatocarpus Schreber (ed.), Gen. Pl. 1 (1789) 86 n.v., nom. illeg.; Willd., Spec. Pl. 1 (1797) 690.

Linociria Necker, Elem. Bot. 3 (1790) 366, nom. illeg.

Goniocarpus Koenig, Ann. Bot. 1 (1805) 546, nom. illeg.; DC., Prod. 3 (1828) 66; Cunn., Ann. Nat. Hist. 3 (1839) 30; Nees, in Lehm., Pl. Preiss. 1 (1844) 158, 2 (1848) 225.

Annual or perennial herbs or small shrubs, up to 4 m tall (usually 10-30 cm), rootstock a simple taproot, stems ascending or erect, smooth or 4-5-ribbed, herbaceous or woody, often rooting at nodes in lower parts, glabrous, scabrous, or pilose with various types of simple hairs.

Leaves sessile or petiolate, exstipulate, alternate, opposite, or rarely, in whorls of 3 (-5), terete, linear, lanceolate or ovate, margin entire or serrate, midrib sunken above, prominent below, glabrous or scabrous, with hairs as for the stems.

Inflorescence an indeterminate spike of single flowers borne in the axils of alternate, opposite or whorled primary bracts. Lateral inflorescences may arise in the axils of the upper leaves. Primary bracts leaflike, grading into upper leaves at base of inflorescence, becoming ± rapidly reduced in size and serrations towards apex. Secondary bracts (bracteoles) borne on pedicels of flowers, linear, lanceolate or ovate (rarely, trifid or toothed), brown, membranous, much smaller than primary bracts.

Flowers (3-) 4-merous on short pedicels. Sepals (3-) 4, deltoid, lanceolate or cordate, often with pronounced midrib and prominent median basal callus, glabrous or scabrous. Petals same in number as sepals, hooded, ± unguiculate, keeled, glabrous or scabrous on keel. Stamens usually twice the number of sepals, filaments short; anthers oblong, 4-locular, non-apiculate, antisepalous anthers slightly longer than antipetalous ones. Styles same in number as sepals, clavate, stigmas capitate. Ovary ovoid to hemispherical, smooth or ribbed opposite sepals and/or petals, ± tuberculate, glabrous or scabrous, incompletely (3-) 4 locular, with 1 (-2) pendulous ovules per locule (if 2, then 1 aborts at an early stage).

Fruits similar in size and shape to ovary, never winged, glabrous or scabrous; sepals persistent, erect, deltoid, lanceolate or cordate, usually with midrib and median basal callus; pericarp ± membranous, septa ± absent, 1 seed, occupying entire fruit.

Gonocarpus, a genus of 36 species, is widespread in Australia and New Zealand and can be found in most parts of these countries. Five species occur in New Guinea and two to four in Indonesia, Borneo, Celebes, Philippines, Japan, Formosa, and the coastal regions of mainland South-East Asia. *G. micranthus* subsp. *micranthus* is found almost throughout the range of the genus (absent only in central and western Australia).

The species occupy a wide range of habitats, ranging from rain-forest to dry rocky hillsides, although most grow in relatively damp localities, often in sclerophyll forest. There are no aquatic species, and only one desert ephemeral in the genus. Some alpine species are normally covered with snow for part of the year. Flowering and fruiting normally occur during mid to late summer. Pollination is usually anemophilous. Most species are potentially perennial, dying back to the rootstock and lower branches after fruiting, and shooting again during the following winter/spring. Some species probably reproduce vegetatively from the creeping or procumbent stems which root at the nodes.

Thunberg spelt the name of the genus '*Gonocarpus*'. The names *Gonatocarpus* Schreber and *Goniocarpus* Koenig were proposed as variants to prevent confusion between *Gonocarpus* and *Conocarpus* L. (Combretaceae). As all the names for the genus in Haloragaceae were based on the same type species (*G. micranthus*), all except *Gonocarpus* are illegitimate.

Gonocarpus was included in *Haloragis* by Robert Brown (1814) when he recognised the family Haloragaceae as distinct from Onagraceae. He was followed by all subsequent authors with the major exception of A.-P. de Candolle (1828). The genus is reinstated in this treatment on the basis of differences from *Haloragis* in characters of the inflorescence, septa, pericarp and development of the fruit.

Whereas in *Haloragis* species the flower at anthesis has a relatively small, unornamented, ± succulent ovary with (usually) 4 locules separated by substantial septa consisting of several layers of close packed cells, the ovary of *Gonocarpus* species at anthesis is already at its full size, ornamented, and has a dry, crustaceous wall. Its septa are insubstantial, of hyphae-like, loosely interwoven cells, and only extend for part of the ovary length. During fruit development in *Haloragis* (after shedding of the petals and stamens), the ovary increases in size by at least 2-3 times, the external ornamentation (wings, calluses, etc.) become apparent at a comparatively late stage, and the septa and inner layers of the pericarp become woody. All of the locules increase in size, whether or not they contain a seed, and the fruit is potentially 4-seeded. In *Gonocarpus* there is little or no change in the size, texture or ornamentation of the ovary during fruit development, only 1 seed per fruit is formed and this increases in size to fill the entire fruit, crushing the septa in the process. The inflorescence in *Haloragis* consists of dichasia of 3-7 flowers in the axils of primary bracts. Only very rarely are the dichasia reduced to a single flower with no trace remaining of abortive laterals. In *Gonocarpus* the primary bracts enclose single flowers. Only specimens of the anomalous species *G. hexandrus* regularly have more than 1 flower per primary bract.

Other qualitative differences include a tendency in *Gonocarpus* for the teeth on the leaves to be obliquely cuspidate, while those of *Haloragis* are deltoid to falcate, and there is a subtle difference in general habit, probably best described as a trend towards a twiggy, multistemmed intricate growth form in *Gonocarpus,* compared with fewer, more woody main stems and less tangled growth in *Haloragis,* although these differences are not absolute.

Key to the species of *Gonocarpus*

1. Primary bracts of inflorescence opposite, at least in lower part.
   2. Leaves opposite; subshrubs or herbs.
      3. Fruits 8-ribbed, with 2-3 oblique calluses between ribs.
         4. Leaves and stems ± densely spreading pilose; ± erect plants; stamens 8.
            5. Fruits opposite at base of inflorescence only. — 1. *G. teucrioides*
            5. Fruits opposite throughout inflorescence. — 2. *G. scordioides*
         4. Leaves with few hairs at base of midrib on lower surface only, stems with appressed hairs in decussate pattern on younger parts only; ± prostrate plants; stamens 4, staminodes 4. — 3. *G. montanus*
      3. Fruits 4-8-ribbed, lacking oblique calluses between ribs.
         6. Leaves linear to terete, ± recurved. — 4. *G. salsoloides*

6. Leaves lanceolate to ovate, flat or channelled, not recurved.
 7. Exocarp membranous; hairs of leaves confined to midrib on lower surface. 5. *G. serpyllifolius*
 7. Exocarp swollen, spongy; leaves pilose on both surfaces. 6. *G. aggregatus*
2. Leaves in whorls of three; shrubby plants or lianes.
 8. Leaves crowded, coriaceous, lanceolate, 3-5 mm long, upper surface glossy, glabrous. 7. *G. sanguineus*
 8. Leaves widely spaced, membranous, lanceolate to ovate, (10-) 15-20 (-40) mm long, upper surface slightly shiny, appressed pilose. 8. *G. halconensis*
1. Primary bracts of inflorescence alternate throughout.
 9. Leaves in whorls of three or opposite, at least in lower parts.
 10. Leaves in whorls of three, at least in the lower parts.
 11. Fruits 8-ribbed, smooth between ribs.
 12. Leaves crowded, coriaceous, lanceolate, 3-5 mm long, upper surface glossy, glabrous. 7. *G. sanguineus*
 12. Leaves widely spaced, membranous, lanceolate to ovate, (10-) 15-20 (-40) mm long, upper surface slightly shiny, appressed pilose. 8. *G. halconensis*
 11. Fruits 8-ribbed, with oblique calluses between ribs. 10. *G. longifolius*
 10. Leaves opposite (often becoming alternate towards inflorescence).
 13. Fruits ± ovoid, 8-ribbed, with 2-3 oblique calluses between ribs.
 14. Stamens 8, all functional.
 15. Subshrubs (35-) 50-100 (-150) cm tall; main stems distinctly woody.
 16. Leaves ovate to oblong; stems and leaves very densely velutinous, with spreading or reflexed hairs 0.1-0.1 mm long. 9. *G. oreophilus*
 16. Leaves linear-oblong; stems and leaves moderately densely spreading pilose with soft hairs 0.3-0.7 mm long. 10. *G. longifolius*
 15. Perennial herbs usually less than 35 cm tall; main stems (if identifiable) herbaceous or only slightly woody.
 17. Leaves lanceolate to linear-lanceolate.
 18. Leaves lanceolate, widest about centre; leaves, primary & secondary bracts and sepals lacking prominent white thickened margins. 12. *G. tetragynus*
 18. Leaves linear-lanceolate, widest towards base; leaves, primary & secondary bracts and sepals with prominent white thickened margins. 14. *G. chinensis*
 17. Leaves ovate to cordate.
 19. Secondary bracts reddish, ovate, toothed; primary & secondary bracts lacking prominent white thickened margins. 17. *G. mezianus*
 19. Secondary bracts greenish, lanceolate, entire; primary & secondary bracts with prominent white thickened margins. 13. *G. implexus*
 14. Stamens 4, antisepalous (sometimes with 4 antipetalous staminodes as well).
 20. Stems spreading pilose; staminodes usually present; prostrate plant with very lax inflorescence. 11. *G. humilis*
 20. Stems appressed pilose; ± erect plants.
 21. Staminodes absent. 15. *G. philippinensis*
 21. Staminodes present. 16. *G. incanus*
 13. Fruit urceolate, cylindrical or ovoid, variously ornamented, but if ovoid, then lacking oblique calluses between ribs.
 22. Fruit urceolate.
 23. Stamens 8.
 24. Leaves ovate, 0.9-1.3 cm long, 0.6-0.8 cm wide, serrate with 12-16 teeth. 32. *G. pycnostachyus*
 24. Leaves ovate to narrow-ovate, 0.25-0.8 cm long, 0.15-0.3 cm wide, entire or 1-4-denticulate. 33. *G. confertifolius*
 23. Stamens 4, antisepalous. 34. *G. nodulosus*
 22. Fruit cylindrical or ovoid.
 25. Fruit cylindrical (almost ovoid in *G. acanthocarpus*).
 26. Fruit 8-ribbed with 3-4 tubercles between ribs.
 27. Tubercles conical; fruit 1.0-1.4 mm long. 19. *G. acanthocarpus*
 27. Tubercles 3-4-angled or faceted; fruit 1.8-2.0 mm long. 20. *G. leptothecus*

26. Fruit smooth between ribs, but with 3-5 glistening papillae on ribs. 27. *G. eremophilus*

25. Fruit ± ovoid, lacking tubercles or calluses between the ribs.

28. Flowers 4-merous.

29. Leaves ovate to orbicular, about as long as broad.

30. Sepals cordate. 22. *G. intricatus*

30. Sepals deltoid to ovate.

31. Leaves and stems pilose.

32. Densely pilose plant; hairs 2-4-celled, 0.1-0.5 mm long. 21. *G. benthamii*

32. Very sparsely pilose plant; hairs unicellular, 0.2-0.3 mm long. 23. *G. diffusus*

31. Leaves and stems glabrous.

33. Primary bracts persistent; fruits borne erect. 23. *G. diffusus*

33. Primary bracts deciduous; fruits nodding. 28. *G. micranthus*

29. Leaves linear to (ob-) lanceolate, at least twice as long as broad.

34. Leaves oblanceolate, usually less than 1 cm long.

35. Hairs 5-7-celled, 0.5-1.5 mm long, dense. 24. *G. rudis*

35. Hairs unicellular, 0.1-0.2 mm long, sparse. 25. *G. trichostachyus*

34. Leaves linear to lanceolate, usually more than 1 cm long (0.7-1.0 cm long in *G. pusillus*).

36. Primary & secondary bracts and sepals with thickened white margins; scabrous plant. 14. *G. chinensis*

36. Primary & secondary bracts and sepals lacking thickened white margins; ± glabrous plant.

37. Herb 5-10 cm tall, leaves linear, 0.7-1.0 cm long. 26. *G. pusillus*

37. Herb 40-65 cm tall, leaves narrow-linear, 2.0-5.0 cm long. 35. *G. paniculatus*

28. Flowers 3-merous. 36. *G. hexandrus*

9. Leaves all alternate.

38. Leaves flattened, lanceolate to narrow-lanceolate, serrate. 18. *G. elatus*

38. Leaves narrow-linear to terete, entire.

39. Perennial herbs 20-45 cm tall, leaves 0.6-) 1.0-3.5 cm long.

40. Sepals cordate, concave. 29. *G. cordiger*

40. Sepals broad-ovate to deltoid, ± planar. 30. *G. pithyoides*

39. Perennial herb 10 cm tall, leaves 0.15-0.2 cm long. 31. *G. simplex*

1. **Gonocarpus teucrioides** DC. (Figs. 192-199)

Gonocarpus teucrioides DC., Prod. 3 (1828) 66 ('Goniocarpus') [Typus: "In Nova-Hollandia. Sieb. pl. exsic. n. 544." Holotypus: *Sieber 544,* 1826, Fl. Novae Holl., P-DC (fl.) (photo!); Isotypi: *Sieber 544,* Fl. Novae Holl., G (herb. Boiss.)!, LE!, W (herb. Bauer, Endl.)! (fl., fr.)].

Haloragis teucrioides (DC.) Schldl., Linnaea 20 (1847) 648; Gray, Bot. U.S. Expl. Exped. 1 (1854) 625; Bentham, Fl. Aust. 2 (1864) 484, 485 p.p.; F. v. M., Census 1 (1882) 50 p.p.; F. v. M., Key Syst. Vict. Pl. 2 (1885) 22, 1 (1887-8) 263; F. v. M., Trans. R. Soc. Vict. 24 (1888) 134 p.p.; F. v. M., Sec. Census 1 (1889) 86; Moore, Hdbk. Fl. N.S. Wales (1893) 186; Bailey, Qld. Fl. 2 (1900) 556; Rodway, Tas. Fl. (1903) 49; Schindler, Bot. Jb. 34. Beibl. 77 (1904) 42; Schindler, Pflrch 23 (1905) 33; Dixon, Pl. N.S. Wales (1906) 130; Britten, J. Bot. 45 (1907) 135, 136; Bailey, Comp. Cat. Qld. Pl. (1913) 175; Maiden & Betche, Census N.S. Wales Pl. (1916) 158; Ewart, Fl. Vict. (1930) 881; Curtis, Stud. Fl. Tas. 1 (1956) 188; Evans, in Beadle et al., Hdbk. Vasc. Pl. Syd. Dist. (1963) 175; Eichler, Suppl. Black's Fl. S. Aust. (1965) 245; Praglowski, Grana 10 (1970) 168; Willis, Hdbk Pl. Vict. 2 (1972) 468; Beadle et al., Fl. Syd. Reg. (1972) 207.

Haloragis elata Hook. f., Lond. J. Bot. 6 (1847) 475, non A. Cunn. ex Fenzl (1837) [Typus: "Hab. Abundant in dry and shaded places:—*v.v.n.*" Lectotypus (Orchard): *Dr. Hooker s.n.,* -.x.1840, V.D.L., Port Arthur, K (herb. Hook.) (fl.)! Syntypi: *J. D. Hooker s.n.,* 1/837, Sydney, Garden Island, K (herb. Hook.) (st.)!; *Hook. f. s.n.,* Tasmania, PR!, UPS!, U118393B! (fl., fr.).]

Haloragis teucrioides δ *elata* (Hook. f.) Sonder, Linnaea 28 (1856) 230.

Haloragis gunnii Hook. f., Fl. Tas. 1 (1856) 120 [based on *H. elata* Hook. f.] Hook. f., Fl. Tas. 2 (1859) 162.

? *Haloragis aenea* Schindler, Pflrch 23 (1905) 34 [Typus: "Australien: Goshew (Smitow).—Herb. Berlin". Holotypus: n.v., probably destroyed].

Goniocarpus tetragynus non Labill.: DC., Prod. 3 (1828) 66.

Figs.: Hook. f., Fl. Tas. 1 (1856) pl. 22; Curtis, Stud. Fl. Tas. 1 (1956) fig. 47; Praglowski, Grana 10 (1970) pl. 3 (e-g).

Erect perennial herb or subshrub 20-35 (-50) cm tall; stems green to reddish, 4-angled, branching mainly from base, moderately densely spreading pilose, hairs white to hyaline, coarse, 2-3-celled simple, 0.2-0.5 mm long, sometimes seated on small multicellular tubercle.

Leaves decussate, petiolate (petioles 1-2 mm long), ovate, (0.45-) 0.7-1.5 (-2.5) cm long, (0.35-) 0.5-1.3 cm wide, base rounded to cordate, apex obtuse, margins thickened, serrate with 10-12 obliquely cuspidate teeth 0.5-1.0 mm long, lamina dark green above, light green below, midrib channelled above, prominent below, lateral veins indistinct, moderately densely spreading pilose on both faces, hairs seated on small tubercles (Figs. 193-195).

Inflorescence an indeterminate spike of flowers borne singly in axils of primary bracts, opposite or subopposite in lower part, becoming alternate above. Primary bracts leaflike, ovate, 2.5-4.5 mm long, 1.5-2.5 mm wide, sessile, entire to ca 4-serrate, very weakly midribbed, tip usually reflexed, glabrous on inner face, spreading pilose on outer face and margins. Secondary bracts membranous or subfleshy, lanceolate, 2.0-2.5 mm long, 0.5-1.0 mm wide, ± concealing ovary, entire (rarely, very shortly 1-2-toothed near apex), sessile, lacking midrib, pilose on outer face (Figs. 196, 197).

Flowers 4-merous, on pedicels 0.5-1.0 mm long (Fig. 198). Sepals 4, deltoid-cordate, 0.6-0.7 mm long, 0.4-0.6 mm wide, margin thickened, median basal callus, glabrous. Petals 4, keeled, hooded, very shortly unguiculate, 2.6-3.3 mm long, 0.5-0.7 mm wide, spreading pilose on keel. Stamens 8, filaments 0.2-0.4 mm long; anthers red to yellow, linear-oblong, 1.7-2.5 mm long, 0.3-0.5 mm wide, 4-celled, non-apiculate, the antipetalous anthers slightly shorter than antisepalous ones. Styles 4, clavate, 0.3-0.5 mm long, stigmas capitate, fimbriate. Ovary silver-grey to reddish, ovoid to globular, 1.1 mm long, 1.1 mm wide, 8-ribbed, 2 (-3) oblique calluses between ribs, glabrous or sparsely papillo-pilose; incompletely 4-locular, 1 ovule per locule.

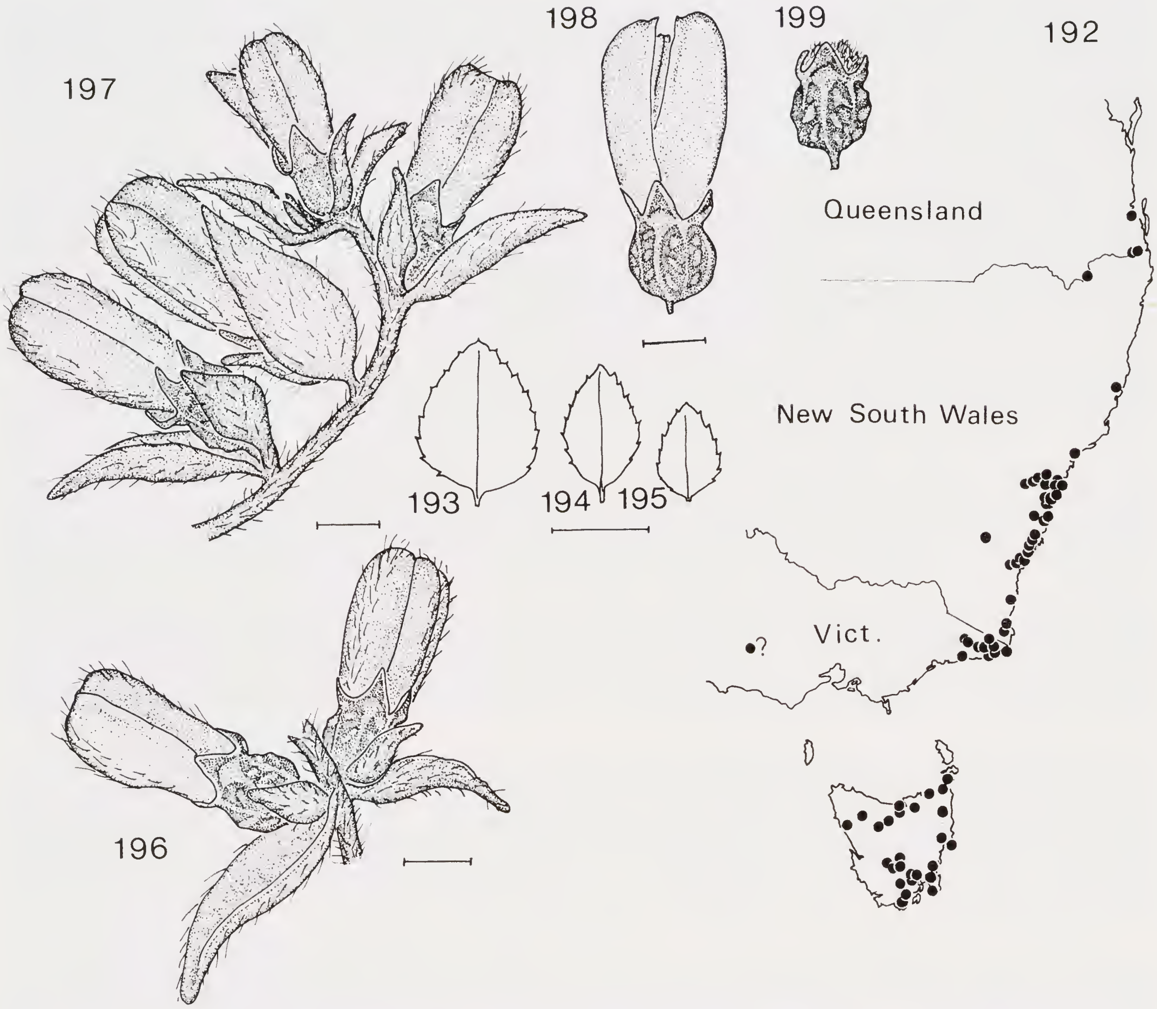
Fruit silver-grey, ovoid, 1.4 mm long, 1.2 mm wide, 8-ribbed with 2-3 oblique calluses between ribs; sepals persistent, erect, deltoid, 0.5 mm long, 0.5 mm wide, margins thickened, median basal callus; pericarp membranous, 1 seed (Fig. 199).

Distribution: *G. teucrioides* is found from Tasmania, through Gippsland and eastern New South Wales to south-eastern Queensland (Fig. 192). Records in the literature of the species being found in South Australia refer to *G. mezianus*.

Ecology: This species usually occurs as an undershrub in sclerophyll forest, where it can be locally abundant. It is found on a variety of soils, from near sea level to about 1200 m. Collectors' notes include "frequent on stony soil in *Eucalyptus gummifera-E maculata-Acacia-Macrozamia* community" (*Adams 1627*); "cleared *Eucalyptus* dry sclerophyll forest, on a slight slope, amongst dolerite rock in a yellow-brown loam" (*Barker 932*); "*Eucalyptus* dry sclerophyll, open due to fallen trees and granite outcrops, dense heath ground cover; in a dark organic top-soil over a loamy sand mixed with quartzite; bees visiting flowers." (*Barker 941*); "on a steep slope in *Eucalyptus obliqua-Casuarina* sp. open forest" (*Barker 984*); "open cut over sclerophyll forest" (*Burbidge 3498*); "margins of rainforest scrub and heathy grassland" (*Craven 679*); "common in sandstone heath" (*McBarron 4091*); "subalpine moor, fringed with wet sclerophyll forest" (*Somerville HO6688*). Flowering and fruiting take place from September-October until about February.

Specimens examined:

QUEENSLAND: Anon. s.n., -.xi.1944, Mt. Norman via Wallangarra, BRI080129 (fr.); *Bailey 484*, -.ix.1875, Brisbane River, BRI (fl., fr.); *Hocking s.n.*, 1961, Wyberba, BRI031502 (fl.); *McDonald 318*, 1.xi.1966, Springbrook, BRI, CANB (fl.); *Orchard 2347, 2353*, 24.x.1969, Springbrook, AD (fl.). *NEW SOUTH WALES: Anon. s.n.*, 25.viii.-., North Shore, MEL39492 (fl.); *Anon. s.n.*, -.ix.1860, Twofold Bay, MEL39449 (st.); *Anon. s.n.*, -.viii.1887, Manly, NSW98904 (fl.); *Anon. 52*, Illawarra, MEL (fl., fr.); *Anon. 53*, 27.ix.1892, Manly, MEL (fl.); *Adams 1627*, 22.xi.1966, Near Nelligen Bridge, Clyde River, CANB, MEL (fr.); *Baeuerlen s.n.*, Milton, MEL 39490 (fl.); *Betche s.n.*, 7.x.1880, North Shore, NSW98903 (fl., fr.); *Blakely s.n.*, -.xi.1919, Florence St., Hornsby, NSW98899 (fl.); *Blakely & Shiress s.n.*, 29.i.1927, Kendalls Glen, Gosford, NSW98906 (st.); *Boorman s.n.*, -.xi.1904, Boonoo Boonoo, NSW99018 (fl., fr.); *Cambage 1434*, 5.xii.1905, Milton, NSW (fl., fr.); *Cambage 3227*, 6.xii.1911, Burragorang Mt., NSW (fr.); *Camfield s.n.*, -.x.1893, Kogarah, NSW98889, 98909 (fl., fr.); *Camfield s.n.*, -.ix.1897, Loftus, AD96920062 (fr.); *Camfield s.n.*, -.xii.1897, Port Jackson district, AD96905158, BRI080132 (fl., fr.); *Camfield s.n.*, -.ix.1898, Port Jackson district, P (fl., fr.); *Camfield s.n.*, 26.ix.1898, Como, NSW98911 (fl., fr.); *Camfield s.n.*, -.xi.1899, Kogarah, NSW98895 (fl.); *Camfield s.n.*, -.x.1900, Kogarah, NSW99080 (fl., fr.); *Camfield s.n.*, -.v.1901, Oatley West, NSW98908 (seedlings); *Camfield s.n.*, 4.viii.1902, Oatley, NSW98910 (st.); *Camfield s.n.*, 21.ix.1902, Oatley Railway, NSW98893 (fl.); *Camfield s.n.*, 10.xi.1902, Carleton to Sans Souci Road, NSW98894 (fl.); *Cleland s.n.*, 1.ix.1910, Neutral Bay, AD96905113 (fl.); *Cleland s.n.*, 29.ix.1912, Newcastle, AD96905136 (fr.); *Constable s.n.*, 6.x.1960, Pt. Perpendicular, Jervis Bay, NSW52726 (fl., fr.); *Craven 679*, 6.xii.1965, Mt. Bundawang, CANB, CHR, MEL, NSW (fl.); *Cross s.n.*, -.iii.1934, Spring-



Figs. 192-199. *Gonocarpus teucrioides*. 192. Distribution. 193-195. Leaves. 196. Basal portion of inflorescence. 197. Tip of inflorescence. 198. Flower. 199. Fruit. (figs. 193-199 from *Hoogland 7744*). Scales represent 1 cm (figs. 193-197) or 1 mm (figs. 198, 199).

wood, NSW98907 (st.); *Daemel s.n.*, 1869, New South Wales, M (fl.); *Day s.n.*, -.x.1936, Killara, CANB10238 (fl., fr.); *Duncan s.n.*, 29.iv.1968, Diamond Head, CBG023946 (st.); *Fletcher s.n.*, 8.x.1887, Narrabeen, AD96920065 (fl., fr.); *Ford s.n.*, 6.i.1959, Tantawangalo Mt., NSW99024 (fr.); *Francis s.n.*, -.xii.1912, Wollongong, NSW98890 (st.); *Gaudichaud s.n.*, Port Jackson, P (fr.); *Goode 453*, 9.x.1961, Serpentine Road, Leura, NSW (fl.); *Goode 531*, 4.xii.1961, Sublime Point, Leura, NSW (fl., fr.); *Greenwood 542*, -.xi.1913, Mittagong, NSW (fr.); *Heron s.n.*, 6.x.1898, Conjola, NSW98876 (fl.); *Heron s.n.*, -.xi.1899, Conjola (fl., fr.); *Hoogland 7744*, 30.x.1960, near Eden, CANB (fl.); *Hooker s.n.*, -.i.1837, Garden Island, Sydney, K (st.) — syntype of *H. elata* Hook. f.; *Johnson 233*, 10.x.1945, Cheltenham, NSW (fl., fr.); *Johnson s.n.*, 1948, Cooper Park, Bellevue Hill, NSW98917 (fr.); *Johnson s.n.*, 6.xi.1948, Georges River, 3 miles [5 km] E. of Leumeah, AD96920063 (fr.); *Johnson s.n.*, 20.xi.1950, Tilba to Wallaga Lake, NSW98877 (fl., fr.); *Lhotsky s.n.*, Argyl, CGE (fr.); *Maiden s.n.*, -.x.1887, Lake Narrabeen, NSW98905 (fr.); *Mauritzon s.n.*, 21.xi.1936, the Zoo near Sydney, UPS (fr.); *McBarron 2329*, 19.x.1948, Nowra, NSW (fl.); *McBarron 4091*, 20.xi.1949, Mt. Ousley, NSW (fr.); *McGillivray 1492*, 24.ix.1965, Vincentia, NSW (fl., fr.); *Meebold 8083*, -.i.1930, Katoomba, M (fr.); *Morris s.n.*, 30.ix.1924, Roseville, ADW16995, NSW 99079 (fl., fr.); *Morris s.n.*, 22.ix.1927, Roseville, NSW98915 (fl.); *Price 3*, -.x.1948, Killara, NSW (fl., fr.); *Pryor s.n.*, 31.viii.1948, Jervis Bay, CBG013190 (st.); *Pullen 4151*, 27.x.1966, Kioloa State Forest, W. of Pebbly Beach, AD, BRI, CANB, MEL (fl.); *Rodd s.n.*, 20.ix.1964, ridge between Colo R. and southern tributary of Angorawa Ck., NSW98914 (fl.); *Rodway s.n.*, -.ix.1920, Bowen Island, Jervis Bay, NSW98886 (fl.); *Rodway s.n.*, -.xii.1925, Bowen Island, NSW98885 (st.); *Rodway sn.*, 30.iii.1930, Woodhill near Berry, NSW98888 (fl., fr.); *Rodway 124*, 18.x.1930, Falls Creek south of Nowra, NSW (fl.); *Rodway 149*, 25.x.1930, Moonie Creek, Huskisson, NSW (fl.); *Rodway 916*, 23.x.1932, Jervis Bay, BISH, NSW (fr.); *Salasoo 865*, 13.x.1951, Hornsby, NSW (fl., fr.); *Salasoo 4713*, 8.i.1971, Bonny Hills, S.W. of Port Macquarie, NSW (st.); *Sieber 544*, Fl. Novae Holl., G, LE, P, W (fl.) — isotypes of *G. teucrioides* DC.; *Stuart s.n.*, New England, MEL39474, 1003758 (fl.); *Tryon s.n.*, Port Jackson, BRI080100 (fr.); *White 5058*, 21.x.1927, Kuring-gai, BRI (fl., fr.); *Wilkes s.n.*, New South Wales, LE (fr.); *Woolls s.n.*, Port Jackson, MEL39454 (st.); *Woolls s.n.*, Paramatta, MEL39495 (fl.); *Woolls*

s.n., Foxground, MEL1003721 (fl., fr.). *VICTORIA: Carroll s.n.*, 18.xii.1965, Sampson's lookout, Marlo, CBG 017984 (fr.); *Calvert K50*, 2.xii.1930, Cann R., CANB (fr.); *Czornij 485*, 9.xii.1971, Genoa Creek track, AD (fr.); *French s.n.*, -.i.1889, near summit of Mt. Ellery, MEL1003653 (fr.); *Maplestone s.n.*, Gabo Island, MEL 39450 (st.); *Merrah s.n.*, 1886, Mt. Ellery, MEL39513, 1003748 (fr.); *Merrah s.n.*, -.viii.1887, sources of the Brodribb River, MEL1003704 (terat.); *Mueller s.n.*, 24.iv.1853, on the Stringybark Ranges towards Gippsland, MEL39515 (st.); *Mueller s.n.*, -.ix.1860, Genoa River, MEL1003720 (st.); *Muir 1867, 1868*, 24.xi.1960, near Davis Creek, 1 mile [2 km] south-west of Mallacoota, MEL (fl., fr.); *Phillips s.n.*, 11.x.1961, near Wingen Inlet, on lower 10 miles [16 km] of track, CBG015440 (fl., fr.); *Sayer s.n.*, 1887, Cann Valley, MEL39510, 39511 (fl.); *Stirling 7*, E. Gippsland, MEL (fl.); *Walter s.n.*, -.x.1892, Grampians, MEL39521 p.p. (fr.). *TASMANIA: Anon. 311*, -.i.1849, Mersey Riv., MEL39503, 39504 (fr.); *Archer s.n.*, -.iii.1848, Mersey, NSW98870 (fl.); *Barker 879*, 3.xi.1970, Fern Tree ca 1½ km south-east of the Huon Highway on Summerleas Road, AD (fl.); *Barker 915*, 6.xi.1970, Prossers Forest Rd, ca 1½ km east of the turnoff from the Lilydale-Launceston road, AD (fl.); *Barker 932*, 8.xi.1970, ca 26 km from Royal George on the Swansea road, AD (fl.); *Barker 941*, 9.xi.1970, Freycinet National Park, track across The Hazards, AD (fl., fr.); *Barker 984*, 22.xi.1970, Holwell Gorge, AD (fl.); *Barker 987*, 22.xi.1970, ridge immediately west of Badger Head, AD (fl., fr.); *Barker 1085*, 9.i.1971, ca 1½ km east of Mt. Pillinger, AD (fr.); *Barker 1117*, 14.i.1971, ca 1½ km east of Fern Tree by the Huon Road, AD (fr.); *Barker 1142*, 17.i.1971, slopes of Mt. Wellington, AD (fl., fr.); *Baudinet s.n.*, 1884, Cape Portland, MEL39499 (fr.); *Burbidge 3498*, 31.i.1949, 9 miles [14 km] north of Waratah, CANB, HO (fr.); *Coates & Sullivan 39*, 1886, Mt. Wellington, MEL (fr.); *Davis s.n.*, -.i.1938, New Harbour, NSW98867 (fr.); *Eichler 16805*, 26.i.1960, Russell Falls, AD (fl.); *Gilbert s.n.*, 13.xii.1952, Florentine Valley, HO6685 (fl.); *Gunn 1958*, 26.x 1843, Asbestos Hills, NSW (fl.); *Hooker s.n.*, -.x.1840, Port Arthur, K (fl.) — lectotype of *H. elata* Hook. f.; *Hooker s.n.*, Tasmania, PR, UPS, U118393B (fl.) — syntypes of *H. elata* Hook. f.; *Jackson 6681*, -.i.1954, Long Plains, Corinna, HO (fr.); *King s.n.*, -.xii.1939, Port Davey, HO6689 (fl.); *Linder s.n.*, 15.xii.1936, Mt. Wellington, UPS (fr.); *Lucas s.n.*, -.xi.1924, Eaglehawk Neck, NSW98873 (fl., fr.); *Maclaine s.n.*, 1894, Clarke Island, MEL39505 (fr.); *Mossman s.n.*, V.Diemans Land, CGE (fr.); *Mueller s.n.*, Tasmania, LE (st.) — syntype of *H. mezianus* (*q.v.*); *Phillips s.n.*, 17.xi.1960, between Glengarry & Deloraine, CBG014789 (fr.); *Phillips s.n.*, 1.ii 1962, near Spring Beach, CBG015444 (fr.); *Phillips s.n.*, 25.xi.1965, Dover, AD97033049, CBG034564, 033917 (fr.); *Phillips s.n.*, 3.xii.1965, Florentine Valley, Wayatinak Road, AD97033047, CBG033915 (fr.); *Robertson s.n.*, Tasmania, NSW98874 (fl., fr.); *Rodway s.n.*, -.x.1898, Cascades, Hobart, NSW98869 (fl., fr.); *Rodway 85*, 2.i.1931, Birch's Bay, CANB, HO (fr.); *Rodway 247*, -.i 1894, Sawpits, Mt. Wellington, HO (fl., fr.); *Rodway 1494*, 14.x.1933, near Port Arthur, NSW (fl.); *Simson 10*, Goulds Country, BRI (fr.); *Somerville s.n.*, 9.iv.1963, Arve River on Hartz track, HO6688 (st.); *Spicer s.n.*, Tasmania, AK72964 (fr.); *Stuart 1709*, -.i.1856, South Port, MEL39501, 39502 (fl., fr.).

The choice of a lectotype for *Haloragis elata* Hook. f. was necessary as there are two collections of this species in Hooker's herbarium, one from Tasmania, the other from near Sydney. The former was chosen as lectotype because it is clearly annotated "Haloragis elata Hook. fil.", as are the duplicate specimens in PR, UPS and U. The Sydney collection has no known duplicates and lacks the above annotation. The name *Haloragis gunnii* Hook. f. is a *nomen novum* for *H. elata* Hook. f., as the latter is a later homonym of *H. elata* A. Cunn. ex Fenzl.

Duplicates of Labillardiere's original collection of *G. tetragynus* from Tasmania, housed in P-DC and FI (herb. Webb — 2 sheets, ex herb. Desf. and Labill.), also represent this species. The P-DC specimen formed the basis of de Candolle's description of *G. tetragynus* in the Prodromus (1828). One syntype of *Haloragis meziana* Schindler (Mueller, Tasmania, LE) is also referrable to *G. teucrioides*, and is the likely cause of the later incorrect lumping of these two species by, for example, Curtis (1956). For further discussion, see *G. mezianus*.

G. teucrioides reaches its northernmost limit near Brisbane, with one possible exception. A sterile collection from Mt. Finnegan, Cape York Peninsula (*Brass 20109*, BRI) has most of the essential features of this species. Fertile material is needed to confirm its tentative identification. Another anomalous location is "Grampians" (*Walter s.n.*, MEL39521). This specimen was mixed on the sheet with plants of *G. humilis*. The record must be considered doubtful, although not impossible, as the species is locally common in eastern Victoria. All other reports of *G. teucrioides* from western Victoria and South Australia refer to *G. mezianus* or (less commonly) *G. humilis*.

G. teucrioides has in the past been confused with *G. mezianus*, *G. tetragynus*, and the previously undescribed *G. oreophilus* and *G. humilis*. From all of these species it is easily distinguishable by its coarse spreading hairs, robust habit, leaf shape, opposite flowers in the lower part of the inflorescence, primary bracts with usually reflexed tips, and fleshy secondary bracts ± concealing the ovary.

The lower stem leaves are much larger than the ones near the inflorescence, and because they are usually deciduous, are often not well represented in herbarium collections. However, in at least some plants, the lowermost leaves occur in whorls of 3 (e.g. *Mueller s.n.*, MEL39515), an arrangement otherwise found only in *G. sanguineus* and *G. halconensis*. Because of other resemblances in, for example, hair type and habit, it seems likely that this similarity reflects relationship rather than convergence.

As in many other species of *Gonocarpus*, occasional plants with functionally female flowers are known, as a result of early abortion of the petals and stamens.

Haloragis aenea Schindler probably belongs here, although there are a few minor points of disagreement in the descriptions, the most important being the metallic sheen reported for the fruits of *H. aenea*. No authentic material of the species has been located during this study.

2. **Gonocarpus scordioides** (Benth.) Orchard (Fig. 200)

Gonocarpus scordioides (Benth.) Orchard, comb. nov.

Haloragis scordioides Bentham, Fl. Aust. 2 (1864) 485 [Typus: "W. Austral'a Thomas River, Maxwell." Holotypus: *G. Maxwell s.n.*, Thomas River, dry indifferent soil, MEL39274 (fl., fr.)! Isotypus: *Anon s.n.*, Thos. River, dry indifferent soil, MEL39275 (fl., fr.)!] F. v. M , Census 1 (1882) 50; F. v. M., Trans. R. Soc. Vict. 24 (1888) 134; F. v. M., Sec. Census 1 (1889) 86; Schindler, Bot. Jb. 34 Beibl. 77 (1904) 30, 42; Schindler, Pflrch 23 (1905) 37-38; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 467.

Figs.: Schindler, Pflrch 23 (1905) fig. 11C; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 467.

Erect or ascending perennial herb or subshrub 10-50 cm tall, stems green to red-brown, regularly branched, ± smooth or weakly 4-ribbed, spreading pilose with simple, uniseriate, hyaline 3-4-celled hairs 0.3-0.5 (-0.8) mm long, often seated on very small tubercles.

Leaves opposite, on petioles 2-4 mm long; lamina ovate to oblong, (1.0-) 1.7-2.5 (-2.8) cm long, (0.6-) 0.8-1.3 cm wide, margin thickened, serrate with 10-14 (-16) obliquely cuspidate teeth 1-2 mm long, upper surface dark green, lower surface lighter, midrib indistinct or channelled above, ± prominent below, lateral veins obscure, scabrous with ± appressed hairs as for stems on both faces (rarely, glabrous above).

Inflorescence an indeterminate spike of flowers borne singly in axils of decussate primary bracts. Lateral inflorescences arise in axils of upper leaves. Primary bracts green, almost indistinguishable from upper leaves, becoming subopposite in upper part of inflorescence, ovate, serrate, midribbed, scabrous. Secondary bracts green to brown, ovate, (0.8-) 1.0-1.3 mm long, 0.5-0.8 mm wide, ± acuminate, entire, scabrous or almost glabrous.

Flowers 4-merous, ± sessile. Sepals 4, green, narrow-ovate, 0.9-1.0 mm long, 0.6-0.7 mm wide, acute, margin thickened, rarely with very small median basal callus, glabrous. Petals 4, reddish, hooded, keeled, non-unguiculate, 2.8-3.4 mm long, 0.6-0.8 mm wide (keel to margin), scabrous on keel. Stamens 8, filaments 0.2-0.3 mm long; anthers yellow to reddish, linear, 2.3-2.6 mm long, 0.3-0.4 mm wide, 4-locular, nonapiculate, the antipetalous anthers usually 0.2-0.3 mm shorter than antisepalous ones. Styles 4, clavate, 0.4 mm long, stigmas capitate. Ovary silver-grey, ovoid to subglobular, 0.7-1.2 mm long, 0.8-1.3 mm wide, irregularly verrucose, or 8-ribbed with lateral calluses radiating from (weaker) antipetalous ribs, scabrous; septa incomplete, 4 locules, 1 ovule per locule.

Fruit ± sessile, green to silver-grey, ovoid, 1.0-1.3 mm long, 1.0-1.2 mm wide, 8-ribbed with lateral calluses radiating from antipetalous ribs, scabrous with semi-appressed hairs; sepals persistent, erect, enclosing styles, ovate, (0.6-) 0.8-1.2 mm long, 0.5-0.6 mm wide, sometimes ± midribbed, glabrous; pericarp membranous, 1 seed.

Distribution: *G. scordioides* is confined to a coastal strip of south-western Western Australia, between Esperance and Cape Arid (Fig. 200).

Fig. 200. Distribution of *Gonocarpus scordioides*.

ECOLOGY: This species is found in light sandy soils, near sea level, often associated with granite outcrops. Collectors' notes include "dry indifferent soils" (*Maxwell s.n.*, MEL); "under shrubs in black loam with a high humus content" (*Orchard 1079*); 'in sandy soil around granite rocks" (*Royce 8825, 10033*); "on mossy granite slabs, here [Boxer Isl.] and on almost every island" (*Willis s.n.*, MEL39276). Flowering occurs in September-October and fruiting from September to December.

SPECIMENS EXAMINED:

WESTERN AUSTRALIA: Eichler 20096, 2.x.1968, Duke of Orleans Bay, AD (fr.); *Maxwell s.n.,* Thomas River, MEL39274, 39275 (fl., fr.) — type of *H. scordioides*; *Maxwell s.n.*, 1875, Cape Arid, MEL1003649 (fl.); *Orchard 1079,* 19.ix.1968, Buyi Billanak Station, Location 248, Neridup, AD (fl.); *Orchard 1144,* 21.ix.1968, Buyi Billanak Station, AD (fr.); *Orchard 1276,* 1.x.1968, Boyatup Hill, AD (fl., fr.); *Royce 8825,* 22.x.1969, Cape le Grand, AD, PERTH (fl.); *Royce 10033,* 3.xii.1971, mouth of Thomas River, PERTH (fl., fr.); *Willis s.n.,* 8.xi.1950, Boxer Island, Recherche Archipelago, MEL39276 (fr.); *Wilson 5542,* 6.x.1966, Cape le Grand, PERTH (fl., fr.).

The affinities of this species seem to lie with *G. teucrioides,* from which it differs mainly in having more oblong leaves and larger, more leaflike primary bracts.

3. **Gonocarpus montanus** (Hook. f.) Orchard (Figs. 201-204)

Gonocarpus montanus (Hook. f.) Orchard, comb. nov.

Haloragis montana Hooker f., Lond. J. Bot. 6 (1847) 475 [Typus: "Summit of Western Mountains, and at Arthur's Lakes; Gunn." Holotypus: *Gunn 257,* 20.xii.1843, summit of W. Mountains, *et* 17.i.1845, Arthur's Lakes, K (Herb. Hookerianum) (fl., fr.)! — both collections mixed on one sheet; Isotypus: *Gunn 257,* 17.i.1845, Arthur's Lakes, NSW99065 (fl., fr.)!] Praglowski, Grana 10 (1970) 174.

Haloragis depressa var. *montana* (Hook. f.) Hook. f., Fl. Tas. 1 (1856) 120; Benth., Fl. Aust. 2 (1864) 485; Bailey, Qld. Fl., 2 (1900) 557.

Haloragis tetragyna var. *diffusa* Hook. f., Fl. N.Z. 1 (1852) 62 [Typus: "Northern Island; abundant in dry places, Banks and Solander, Cunningham, etc." Holotypus: *Sir J. Banks & Dr. Solander s.n.*, 1769, Nova Zelandia, in collibus apricis prope Opuragi, Totaranui, BM (fl., fr.)! (see discussion below); Isotypus: *Banks & Solander s.n.,* 1769-70, New Zealand, AK100922 (fr.)!] Hook. f., Handbk. N.Z. Fl. (1867) 65; Kirk, Stud. Fl. N.Z. (1899) 148; Britten, J. Bot. 45 (1907) 136.

Haloragis aggregata var. *diffusa* (Hook. f.) Schindler, Pflrch 23 (1905) 34; Britten, J. Bot. 45 (1907) 136.

Haloragis diffusa (Hook. f.) Cockayne, Rep. Bot. Survey Stewart Isl. (1909) 57, non *H. diffusa* Diels, Bot. Jb. 35 (1904) 447.

Haloragis procumbens Cheeseman, Trans. N.Z. Inst. 42 (1909) 202 [Typus: Based on *H. tetragyna* var. *diffusa* — type as for that taxon] Moore, in Allan, Fl. N.Z. 1 (1961) 246; Cambie et al., N.Z. J. Sci. 4 (1961) 616.

Haloragis depressa non (A. Cunn.) Walp.: Rodway, Tas. Fl. (1903) 49 p.p.

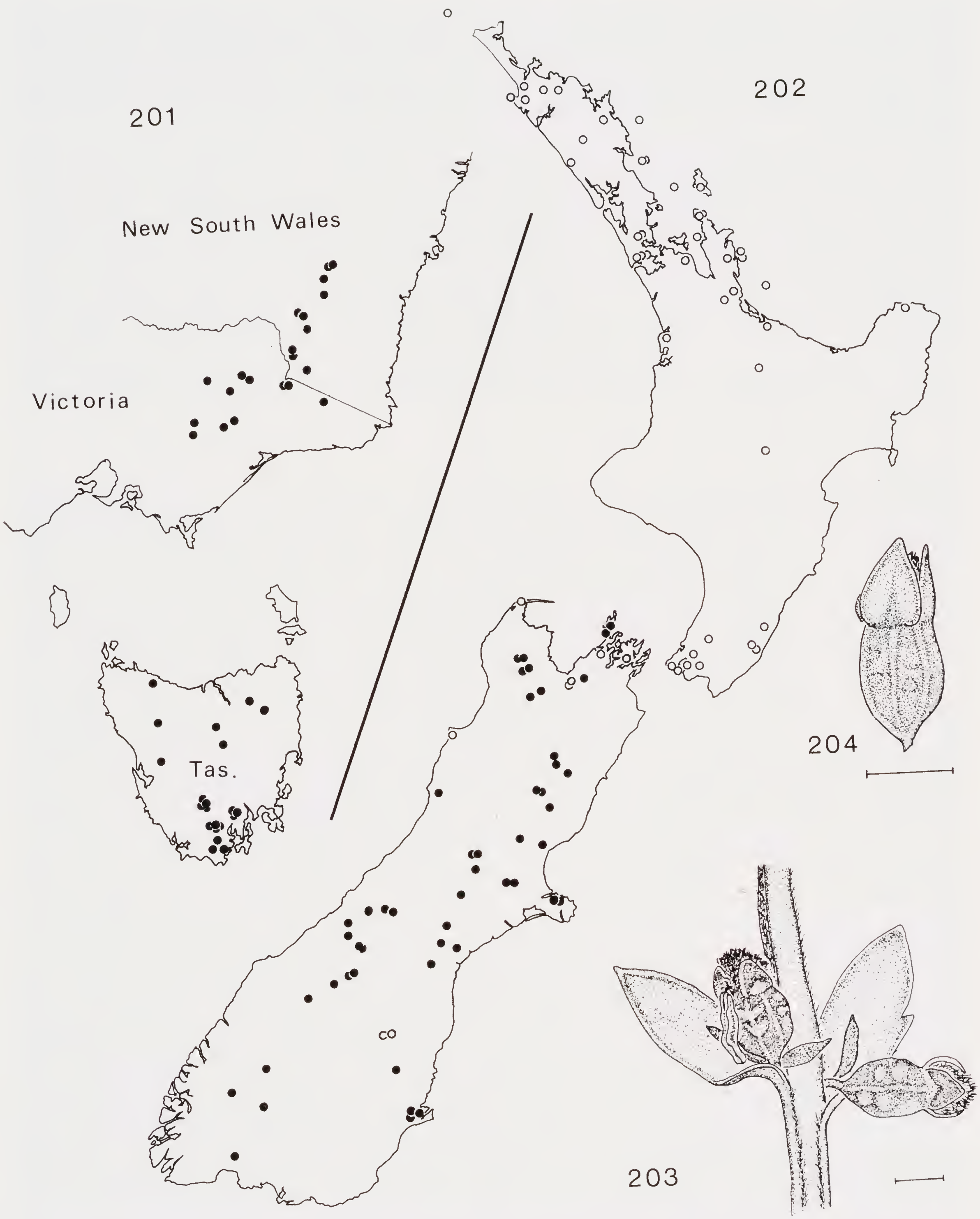
Haloragis serpyllifolia non (Hook. f.) Walp.: Curtis, Stud. Fl. Tas. 1 (1956) 188-9 p.p.; Burbidge & Gray, Fl. A.C.T. (1970) 280.

Procumbent or ascending perennial herb (5-) 10-15 (-20) cm tall, stems green to reddish, 4-angled, appressed pilose on two sides (above leaves), ± glabrous on other two sides, sometimes rooting at lower nodes. Leaves bright green to bronze, decussate, ovate to broad lanceolate, 3.5-6.0 (-15) mm long, 2.0-3.5 (-9.0) mm wide, on petiole 1 (-3) mm long; lamina coriaceous, apex acute to obtuse, margin thickened, serrate with 4-6 (-10) teeth 0.2-0.8 mm long, midrib indistinct, lateral veins obscured, glabrous, or sparsely pilose on midrib of lower surface and petiole only, hairs simple, uniseriate, transparent, 1-2-celled, 0.3-0.4 mm long.

Inflorescence an indeterminate spike of flowers borne singly in axils of primary bracts (Fig. 203). Lateral inflorescences arise in axils of upper leaves. Primary bracts decussate in lower part of inflorescence, usually becoming alternate above, green, leaflike, ovate to broadly-ovate, 2.0-4.0 mm long, 1.0-2.0 mm wide, coriaceous, margin thickened, entire, or (lower bracts) 2-4-serrate, glabrous. Secondary bracts red-brown, membranous, lanceolate, 0.8-1.5 mm long, 0.2-0.4 (-0.8) mm wide, minutely and sparsely pilose on outer face.

Flowers 4-merous, on pedicels 0.2-0.5 mm long. Sepals 4, deltoid, 0.9-1.0 mm long, 0.7-0.8 mm wide, margin thickened, well-defined median basal callus, glabrous. Petals 4, hooded, keeled, shortly unguiculate, 1.5-1.8 mm long, 0.4-0.5 mm wide (keel to margin), glabrous, or with very sparse hairs on keel. Stamens 4, antisepalous, filaments 0.2 mm long; anthers oblong, 0.8-1.2 mm long, 0.3 mm wide, 4-celled, non-apiculate; staminodes 4, antipetalous, up to 0.5 mm long. Styles 4, clavate, 0.5 mm long, stigmas red, capitate, fimbriate. Ovary silvery-grey to reddish purple or metallic bluish grey, ovoid, 1.5-1.6 mm long, 1.0-1.2 mm wide, 8-ribbed, often with 2 oblique calluses between each pair of ribs, glabrous; incompletely 4-locular, 1 ovule per locule.

Fruit ± sessile, ovoid, (1.2-) 1.5-1.6 mm long, 1.0-1.1 mm wide, 8-ribbed, often with 2 ± oblique calluses, glabrous; sepals persistent, erect, deltoid, 0.6-0.8 mm long, 0.6-0.7 mm wide, ± enclosing styles, margins thickened, basal deltoid callus; 1 seed (Fig. 204).



Figs. 201-204. *Gonocarpus montanus*. 201. Distribution in Australia. 202. Distribution of *G. montanus* (●) and specimens intermediate between *G. montanus* and *G. incanus* (○) in New Zealand. 203. Portion of inflorescence of *G. montanus* (from *Travers s.n.*, PR). 204. Fruit (from *Eichler 14651*). Scales represent 1 mm (figs. 203, 204).

DISTRIBUTION: *G. montanus* is widespread in the highlands of Tasmania, the Eastern Highlands and Snowy Mountains of Victoria/New South Wales, Mt. Gingera in the Australian Capital Territory, and in the South Island of New Zealand, particularly above 300 metres, from about Dunedin north. Plants that closely approach this species in most respects, occur throughout the North Island of New Zealand to latitude 35°N, and on the offshore islands, and are listed under this species (Figs. 201, 202). See discussion below.

ECOLOGY: This species is usually found in alpine or subalpine localities, usually between 900 and 2000 metres, although the anomalous specimens in the North Island of New Zealand descend almost to sea level in some cases. It is usually found in open habitats, associated with tussock grasses or alpine heath. Collectors' notes include "Near summit of dolerite outcrop. Exposed, with vegetation of sparse low bushes of *Orites, Phebalium, Richea,* etc. Amongst rocks in a dark shallow moist loam" (*Barker 1102*); "alpine heath. Dolerite. Prostrate perennial forming the most predominant ground cover in area" (*Barker 1133*); "Amongst boulders of scree and on the underlying sandstone" *(Barker 1148*); "open exposed slopes" (*Barker 1172*); 'Snowgum woodland, with dense shrub patches often around the granite outcrops; in tussock grasses" (*Barker 1620*); "granite debris at bush line" *(Hay CHR73716*); "common in steep gully, seeming to prefer moister sheltered spots; stems lax, forming dense, low mounds, or creeping beneath shrubs" (*Rodd 567*). Flowering takes place from October until February, and fruiting from November until April.

SPECIMENS EXAMINED:

TASMANIA: Anon s.n., Van Dieman's Land, MEL1003787 (fl., fr.); *Barker 1102,* 11.i.1971, ca 3 km north-west of Legges Tor, Ben Lomond Nat. Park, AD (fl.); *Barker 1120,* 15.i.1971, summit of Mt. Wellington, AD (fl.,); *Barker 1130, 1133,* 15.i.1971, upper slopes of Mt. Wellington, on road from The Pinnacle, AD (fl.); *Barker 1148,* 17.i.1971, upper slopes of Mt. Wellington, at the Organ Pipes track turnoff, AD (fl., fr.); *Barker 1161,* 19.i.1971, Mt. Field Nat. Park, above Sitzmark Lodge on the Rodway-Mt. Field West track, AD (fl.); *Barker 1172,* 19.i.1971, Mt. Field National Park, ca 1200 m. north-west of Clemes Tarn, AD (fl.); *Barker 1199,* 23.i.1971, along the road into Hartz Mountains National Park, ca 5 km from the car park at its end, AD (fr.); *Brown s.n.,* Table Mountain, MEL39396 (fr.); *Burbidge 3020,* 9.i.1949, upper slopes of Mount Barrow, CANB, HO (fl.,fr.); *Burbidge 3287,* 22.i.1949, near Lake Dobson, CANB, HO (fl., fr.); *Canning 2282,* 2.ii.1969, Mt. Field National Park, AD CBG (fl., fr.); *Cambage & Maiden s.n.,* 11.i.1902, Mt. Wellington, NSW99069 (fl., fr.); *Gauba 485,* 5.iii.1951, Mt. Field National Park, CBG (st.); *Gunn s.n.,* Tasmania, P (fl.); *Gunn 257,* 20.xii.1843, summit of W. Mountains, K (fl., fr.) — holotype of *H. montana*; *Gunn 257,* 17.i.1845, Arthur's Lakes, K, NSW (fl., fr.) — isotype of *H. montana*; *Hooker s.n.,* Tasmania, PR (fl.); *Hooker s.n.,* -.xii.1855, Southport, MEL39398 (st.); *Hooker s.n.,* Mt. de la Perouse, MEL39399 (fl., fr.); *Lucas s.n.,* Mt. Wellington, NSW99072 (fl., fr.); *Maiden s.n.,* -.i.1902, Mt. Wellington, AK72961 (fr.); *Maiden & Cambage s.n.,* -.i.1902, Mt. Wellington, NSW99064 ("20") (fr.); *Mueller s.n.,* -.i.1889, Mt. Field East, MEL39395 (fl.); *Olsen s.n.,* 21.i.1939, Hartz Mountains, HO6700 (fl.); *Phillips s.n.,* 17.i.1962, Lake Dobson, Mt. Field National Park, CBG015622 (fl., fr.); *Phillips s.n.,* 19.i.1962, Hartz Mountains National Park, CBG015623 (fl., fr.); *Phillips s.n.,* 19.xi.1965, 26 miles [41.5 km] N. of Rosebery and 8 miles [13 km] S. of turnoff to Waratah, AD97033048, CBG033916 (fl.); *Phillips s.n.,* 21.xi.1965, 11 miles [18 km] from Queenstown towards Hobart, CBG019289 (fl., fr.); *Phillips s.n.,* 26.xi.1965, Hartz Mountain, CBG015621 (fl.); *Rodway s.n.,* -.xii.1900, Ironstone Range, NSW99071 (st.); *Rodway s.n.,* -.i.1901, Mt. Wellington, NSW99070 (fl.); *Rodway 102,* 26.iii.1932, near Tarn, Wombat Moor, CANB, HO (fr.); *Somerville s.n.,* Arve R., Bridge I near old Kermandie Track, HO (fr.); *Somerville s.n.,* -.i.1939, Hartz track, HO (fl., fr.); *Whaite & Whaite 2276,* 21.i.1961, saddle between Adamson's & Max Peak, NSW (fl., fr.); *Whaite & Whaite 2335,* 26.i.1961, Hartz Mts. Hut, NSW (fr.). *VICTORIA: Barker 1494,* 25.xii.1971, Holmes Plain, ca 3 km along Howitt Road from the junction of the Moroka Road and road to Licola at Mt. Harbuckle, AD (fl.); *Barker 1530,* 27.xii.1971, on the Licola-Mt. Skene road, ca 7 km NW of Connor Plain, AD (fl.); *Barker 1620,* 12.i.1972, on the extreme summit area of Mt. Cobberas no. 1, AD (fr.): *Cambage 3734,* 19.i.1913, Mt. Buffalo, NSW (fl., fr.); *Carroll s.n.,* 22.xii.1965, Echo Flat, Lake Mountain, CBG017924 (fl., fr.); *Cullimore 209,* 16.i.1968, 52 miles [84 km] direct line north of Sale, AD, MEL (fl. fr.); *Eichler 14651,* 1.ii.1958, Falls Creek Ski Village, Bogong High Plain, AD (fr.); *Merrah s.n.,* -.v.1887, Delegate River, MEL1003701 (st.); *Mueller s.n.,* -.ii.1854, Mount Cobberas, MEL39389 (fl.); *Mueller s.n.,* -.xii.1862, Mt. Useful, MEL39394, 39397 (st.); *Muir 708,* 21.i.1959, Wilkinson Memorial Hut, Bogong High Plain, MEL (fl., fr.); *Rodd 567,* 28.xii.1967, Mt. Bogong, NSW (fl.); *Stewart s.n.,* 9.i.1950, Mt. Buffalo, BRI080108 (fl., fr.); *Tadgell s.n.,* -.xii.1914, Mt. Hotham, MEL39392 (fr.); *Wakefield 2624,* 4.i.1949, Nunniong, NSW (fr.). *NEW SOUTH WALES: Baeuerlen 135,* -.iii.1890, Thredbo River, MEL (fr.); *Burbidge 6397,* 27.v.1959, between Mt. Gingera and Blackfellows Gap, CANB (fr.); *Carroll s.n.,* 17.i.1966, Happy Jacks Plains, CBG017404 (fr.); *Maiden & Forsyth s.n.,* -.i.1899, Mt. Kosciusko, AK72963, NSW99102 p.p. (fl., fr.); *Maiden & Forsyth s.n.,* -.i.1900, Mt. Kosciusko, NSW99067 (fl.); *Moore 2410,* 5.iii.1953, Mt. Gingera, CANB, NSW (fr.); *Mueller s.n.,* -.i.1874, Munyang Mountains, MEL 39393, NSW99066 (fl., fr.); *Phillips 8,* 30.iv.1968, Sawyers Hill near Kiandra, CBG (fr.); *Rodd 983,* 29.iii.1970, ¼ mile [½ km] W. of Murrays Gap, Bimberi Range, NSW (st.); *Thompson s.n.,* 17.i.1958, head waters of the Happy Jack River, NSW99063 (fl.); *Thompson 1294,* 16.i.1972, Daners Gap, Kosciusko National Park, NSW (fl., fr.); *Thompson 1379,* 19.i.1972, Snowy R. between Guthega Dam and Spencers Creek, NSW (fl., fr.); *Thompson 1426,* 22.i.1972, upper Snowy R., NSW (st.). *SOUTH ISLAND: Anon. s.n.,* 12.xii.1945, Cape Farewell, WELT35446 (fl., fr.); *Anon. s.n.,* 14.i.1972, Mt. St. Patrick, Upper Clarence Valley, CHR228699 (fl.); *Allan s.n.,* Mt. Peel, CHR11356 (st.); *Allan s.n.,* 2.iii.1950, Clarence Valley, Pass at head of tributary of Percival River, CHR87706 (fr.); *Aston s.n.,* 30.xi.1924, Flagstaff, WELT42672 p.p. (fr.); *Barker 464,* 15.i.1938, Mossburn, CHR (fl., fr.); *Baxter s.n.,* 12.i.1966, Jacks Pass, Hanmer, CHR166409 (fl., fr.); *Brockie s.n.,* -.iv.1934, Jollies Pass, Hanmer, CHR221683 (fr.); *Brownlie s.n.,* 13.v.1957, Betwixt, CANU287, 3125 (st.); *Burrows s.n.,*

- xii.1960, Jacks Pass, CANU3124 (st.); *Burrows s.n.*, -.viii.1963, Ashburton R., CANU6503 (st.); *Burrows s.n.*, Waipara Gorge, CANU6883 (fr.); *Cheeseman s.n.*, -.i.1881, Buller Valley, AK5928 (fr.); *Cheeseman s.n.*, -.i.1886, Mount Arthur, AK5929 (fl., fr.); *Crosby-Smith s.n.*, Sunnyside, Waiau R., WELT40789 (fl., fr.); *Connor s.n.*, 25.i.1960, Ribbonwood Stn., Diadem Range, CHR122048 (fl.); *Connor s.n.*, 11.ii.1961, Von Junction, CHR 122557 (fr.); *Connor s.n.*, 16.i.1962, Rockwood Ra., western slopes, CHR173495 (fr.); *Connor & MacRae s.n.*, 5.xii.1962, Mt. Bernard (Purple Hill) road to Craigieburn Stn., CHR173322 (fl., fr.); *Connor & MacRae s.n.*, 15.xii.1962, Greta Stream, slopes of Ben Ohau, CHR173351 (fl., fr.); *Connor & MacRae s.n.*, 19.xii.1962, "Glen Tanner", slopes above Twin Stream, CHR173393 (fl.); *Gibbs 222*, summit Spooners Range, CHR117726, 144491 (st.); *Hay s.n.*, 6.i.1952, School Hill, Kenepuru Head, CHR76891 (fr.); *Hay s.n.*, 18.xi.1950, Kenepuru Heads, CHR73715 (fl., fr.); *Hay s.n.*, 2.i.1951, Gordon's Pyramid, Mt. Arthur Range, CHR73716 (fl., fr.); *Holloway s.n.*, Flagstaff, OTA001811 (fr.); *Hynes s.n.*, 14.i.1961, bank of Cobb Dam, AK70331 (fl., fr.); *Hynes s.n.*, 20.i.1965, Mt. Sebastopol, near Hermitage, AK104799 (fl., fr.); *Irwin s.n.*, 8.iii.1970, Mt. Kyeburn, CHR201768 (fr.); *Kelly & Kelly s.n.*, -.xii.1972, Round Hill recreation reserve, Croisilles Harbour, CHR235564 (fr.); *Laing 5787*, Mt. Keretu, M (st.); *Lloyd s.n.*, 29.iii.1958, above Woodbank Station, CANU3127 (st.); *Macmahon 198*, Pelorus Valley, AK (fr.); *Macmillan s.n.*, 2.v.1964, Andrews Creek, S. Liebig Range, CHR193895 (st.); *Macmillan 72/505*, 16.ii.1972, Stony Bay Road to Flag Peak, Banks Peninsula, CHR (fr.); *Macmillan & Woodhouse 72/1290*, 15.xii.1972, Hunters Hills, Weaner Run, CHR (fl.); *Mason & Moar 4674*, 14.ii.1957, Lake Sylvester, Cobb Valley, CHR (fr.); *Mitchell s.n.*, -.xii.1942, View Hill, Oxford, CHR130802 (fl., fr.); *Moore s.n.*, 27.iii.1952, Porters Pass, CHR69339 (fr.); *Moore s.n.*, 19.ix.1953, L. Ohau, CHR83599 (st.); *Moore s.n.*, -.i.1957, Wilderness, Te Anau, CHR76037 (fl., fr.); *Moore 33*, 14.xi.1970, Ashley Forest below Lake Janet, CHR (fl.); *Oliver s.n.*, 23.xi.1942, Kapowai Track, d'Urville Is., WELT6890, 40824 (fl., fr.); *Oliver s.n.*, 9.ii.1943, Bald Spur, d'Urville Is., WELT6891 (st.); *Oliver s.n.*, 17.ii.1943, Catherines Cave, d'Urville Is., WELT40831 (fr.); *Oliver s.n.*, 12.xii.1945, Cape Farewell, WELT6893 (fr.); *Oliver s.n.*, 29.xii.1949, Cape Farewell, WELT6867 (fr.); *Parris s.n.*, 9.i.1967, Dun Mountain, AK129530 (fl., fr.); *Petrie s.n.*, Mt. Arnold, Lake Hawea, WELT40796 p.p. (fr.); *Petrie s.n.*, -.ii.1890, Albertown near Lake Wanaka, WELT40795 (fl., fr.); *Petrie s.n.*, -.xii.1890, Signal Hill, Dunedin, WELT40785 (fl., fr.); *Robins s.n.*, 2.xii.1967, N. of White Horse Creek, S. of Westport, CHR182098 (fl., fr.); *Sainsbury s.n.*, -.xii.1922, Dunn Mts., CANTY797 (fl., fr.); *Scott s.n.*, 18.ii.1958, mid Godley R. valley, OTA004402 (fl.); *Simpson s.n.*, 27.xi.1930, Flagstaff Hill near Dunedin, CHR87715 (fr.); *Simpson s.n.*, 10.i.1940, Flagstaff Hill, CHR205003 (st.); *Simpson 4765*, 24.x.1965, Cape Farewell, CHR (fl.); *Simpson & Chapman 6622*, 11.i.1972, Stony Bay Park, Banks Peninsula, CHR (fl., fr.); *Thomson s.n.*, -.xii.1879, nr. Dunedin, CANTY796, BRI079995 (fl., fr.); *Thomson s.n.*, -.i.1878, Mt. Ida, BRI080097 (fr.); *Travers s.n.*, -.i.1909, Hanmer, M, PR (fl., fr.); *Wilson 221*, -.i.1967, Mt. Sebastopol, CHR (fl., fr.). *NORTH ISLAND: Adams s.n.*, Thames District, AK100935 (fr.); *Allan s.n.*, 10.xii.1941, hill west of Whangaroa, CHR87708, 87099 (fl., fr.); *Ashwin s.n.*, 8.i.1955, Butterfly Creek, Wellington, CHR87713 fr.); *Aston s.n.*, Kaimanawas, WELT42701 (fr.); *Aston s.n.*, Wellington, WELT42703 (fl., fr.); *Attwood s.n.*, 7.i.1939, Paremoremo, AK100961 (fr.); *Baylis s.n.*, 20.ii.1934, Great Island, Three Kings, AK23017 (st.); *Baylis s.n.*, 3.xii.1945, Great Island, Three Kings, AK22849 (fl., fr.); *Baylis s.n.*, 30.xii.1947, Great Island, Three Kings, AK24130 (fl., fr.); *Beever & Jane s.n.*, 27.viii.1964, Motu Muka Island, Hen & Chickens Group, AK106097 (st.); *Burke s.n.*, 28.viii.1970, Puketurua Expt. Basin, WELTU2644 (st.); *Carse s.n.*, -.xi.1899, Te Karaka flat, CANTY791 (fl., fr.); *Carse s.n.*, 10.xi.1900, Te Karaka Flat, CANTY790 (fl.); *Carse s.n.*, -.i.1912, Polynoda Bush, Tauroa, CANTY799 (fl., fr.); *Carse s.n.*, 19.xii.1918, Polynoda Bush, Tauroa, CANTY798 (fl., fr.); *Carse s.n.*, 17.x.1920, Peria Gum Hills, CANTY800 (fl., fr.); *Carse s.n.*, 6.xi.1921, New Lynn, CANTY793 (fl., fr.); *Carse s.n.*, 24.i.1922, Titirangi, CANTY794 (fl., fr.); *Carse s.n.*, -.ix.1927, Kaitaia, AK100936 (fl., fr.); *Carse s.n.*, -.xii.1929, Paeroa, CANTY795 (fl., fr.); *Carse & Matthews s.n.*, -.i.1919, Gt. Barrier Island, CANTY767 (st.); *Cooper s.n.*, 10.iii.1965, ridge to Papakauri, Kawakawa-Orere Pt. road, AK122404 (fr.); *Cooper s.n.*, 18.iv.1967, 2 miles [3 km] N. of Tairua, AK127191 (st.); *Cooper, Mason & Moar s.n.*, 28.xi.1949, top of Ahipara Hill, AK35713, 35720 (fr.); *Court et al. s.n.*, 20.viii.1973, Penguin Island off Tairua, AK133249 (st.); *Court et al. s.n.*, 24.viii.1973, Shoe Island off Tairua, AK133233 (st.); *Druce s.n.*, 27.ii.1947, Rewa forest area, E. Wairarapa, CHR82232, 51898 (fr.); *Druce s.n.*, 24.xi.1954, Silverstream, CHR87134 (fl., fr.); *Druce s.n.*, -.xi.1967, Soil Bureau Property, Taita, CHR179600 (fl.); *Druce s.n.*, -.ix.1971, Alfredton-Tinui Road, Wairarapa, CHR222511 (st.); *Esler 3526*, 7.xi.1971, Motuwi, Coromandel Islands, CHR (fl., fr.); *Hamilton s.n.*, 14.i.1956, Little Barrier Island, CHR95474, 95475 (st.); *Healy 553*, 20.vi.1937, Wainui-o-mata Valley, CHR (st.); *Hynes s.n.*, 22.xi.1959, Mayor Island, AK51576 (fl., fr.); *Hynes s.n.*, 27.viii.1964, Motu Muka Island, Hen & Chickens Group, AK103946 (st.); *Hynes s.n.*, 20.vi.1970, Orere Point, AK125510 (st.); *Kirk s.n.*, Auckland, AK42677, OTA015941, WELT40810 (fr.); *Mason s.n.*, 1.i.1940, Silverstream, CHR23311 (fr.); *Mason & Moar 225*, 28.xi.1949, Ahipara, Gumlands Road, CHR (fl., fr.); *Meebold 5286*, -.ix.1929, Birkdale, M (st.); *Moore s.n.*, 6.iv.1931, Big Rock, Port Charles, Coromandel, CHR87709 (st.); *Moore s.n.*, 15.iv.1931, Moehau Trig. CHR87707 (fl., fr.); *Moore s.n.*, 8.iv.1939, Moehau, CHR22587 (fr.); *Moore s.n.*, 9.i.1955, Silverstream, CHR87714 (fr.); *Moore s.n.*, 3.xii.1955, between Lowry Bay and Pt. Howard, CHR95635 (fl., fr.); *Moore s.n.*, 3.ix.1960, Lake Pounui, CHR124145 (st.); *Moore & Cranwell s.n.*, 14-17.xi.1933, Hen Is., Hen & Chickens Group, AK100926, 100934 (fl.); *Moore & Cranwell s.n.*, 26.xi.1934, Manuka Bay, Hen Is., AK100933 (fr.); *Oliver s.n.*, 4.iii.1920, Mt. Maunganui, WELT6888 (st.); *Oliver s.n.*, 1.xii.1924, Poor Knights Is., WELT6894, 35349 (fr.); *Oliver s.n.*, 8.iv.1951, Rimutaka Ra., WELT39455 (fr.); *Petrie s.n.*, -.xi.1894, Rotorua, WELT40792 (fl.); *Petrie s.n.*, -.iii.1896, Paeroa, WELT40791 (fr.); *Petrie s.n.*, Raglan township, WELT40794 (fl., fr.); *Petrie s.n.*, -.xi.1903, Waihi, CHR117718, WELT40790 (fl., fr.); *Phillips-Turner s.n.*, -.ii.-, Mayor Island, AK100925 (fr.); *Purdie s.n.*, 2.xi.1970, Taharoa Lakes, Dargaville, CHR214031 (fl.); *Ritchie & Ritchie s.n.*, 26.x.1968, Coppermine Island, CHR186843 (fl.); *Sneddon s.n.*, 12.xii.1967, midway between Potaka and Cape Runaway, WELTU7194 (fr.); *Sneddon s.n.*, -.xi.1970, Butterfly Creek Track, Eastbourne, WELTU11585 (fr.); *Tryon s.n.*, Auckland, BRI080105 (st.); *Wall s.n.*, -.i.1922, Chelsea, CANTY721 (fr.); *Zotov s.n.*, -.iii.1937, Hataitai, CHR18346 (fr.).

In its most distinctive form *G. montanus* has ± glabrous leaves with only a few hairs at the base of the midrib on the lower surface, the hairs on the younger stems are arranged on opposite sides of the internodes, directly above the leaves (the arrangement decussate to match the leaves), the fruits are glabrous, weakly or un-ornamented between the ribs and the lower flowers and fruits are arranged

decussately, only becoming spirally arranged in the upper part. This form occurs in the South Island of New Zealand, Tasmania, Victoria and New South Wales, and similar plants occur occasionally on the off-shore islands of North Island, New Zealand. Specimens from the mainland of the North Island, however, as well as most of those on the off-shore islands, and a few from the lowlands of northern South Island, show characters indicating a greater or lesser degree of introgression with *G. incanus*. These intermediate forms have leaves which (at least in their younger stages) are evenly and sparsely appressed pilose, and lack the distinctive hair pattern on the younger stems. However, those plants which have glabrous fruits with weak ornamentation between the ribs and at least the 2 lower fruits opposite have been included in *G. montanus* in this treatment.

Hooker referred to two distinct Gunn collections in his description of *Haloragis montana,* and strictly speaking, one of these should be chosen as lectotype. However, on the type sheet in K, both collections have been mounted together, with no indication which specimens belong to which labels. As all the specimens on the sheet belong to this species, the simplest solution is to nominate the whole sheet as holotype.

The typification of *H. tetragyna* var. *diffusa* and its later recombinations and replacements also poses some problems. In 1852 Hooker recognised two varieties of *H. tetragyna.* The second of these, var. *β*, was unnamed (the first word of the description "diffusa" was un-italicised; elsewhere in the book, words intended as epithets are in italics), and based on the unpublished *Cercodia procumbens* Banks et Sol. The only indication of localities and specimens was "Hab. Northern Island; abundant in dry places, *Banks and Solander, Cunningham, etc.*" The Cunningham collection referred to is the type of *Cercodia incana* which Hooker placed in synonymy under the species description. The Banks and Solander collections were made during Capt. Cook's First Voyage at "Opuragi" (= Mercury Bay, Coromandel Peninsula, 5-16 Nov. 1769) and "Totaranui" (= Queen Charlotte Sound, 16 Jan.-6 Feb. 1770). Apparently these two collections were combined, and there is now no way of telling which of the fragments on the type sheets in BM and AK came from which locality. However all are of the intermediate form of the species discussed above, with glabrous, unornamented fruits, the younger leaves appressed pilose, but becoming glabrous with age. In only one inflorescence (on the BM sheet) can the arrangement be discerned, and on this the lower 2 buds are opposite. In 1867, Hooker again referred to his var. *β*, but this time definitely indicated that it was to be called *diffusa.* There is a direct reference to the earlier publication. The locality indicated was "common there [Bay of Islands] and at Auckland. I have seen no Middle Island [= South Island] specimens." Strictly speaking then, only Banks and Solander's collection from North Island (Opuragi) can be considered as type material, although a more reasonable view is that Hooker was ignorant of the exact provenence of the Banks and Solander collections. In any case, as they are apparently mixed in BM and AK, the same procedure as that adopted in the case of *H. montana* is the only one possible. The entire sheet at BM is designated holotype of *H. tetragyna* var. *diffusa* Hook. f., and the sheet in AK is an isotype. The names *H. aggregata* var. *diffusa* (Hook. f.) Schindler, *H. diffusa* (Hook. f.) Cockayne and *H. procumbens* Cheeseman are all based on *H. tetragyna* var. *diffusa* Hook. f. and therefore have the same type.

4. **Gonocarpus salsoloides** Rchbch. ex Spreng. (Figs. 205-209)

Gonocarpus salsoloides Rchbch. ex Sprengel, Syst. Veg. 4 (1827) Cur. Post. 48 ('Goniocarpus') [Typus: Not cited. Holotypus: [Sieber] 249, Fl. Novae Holl., "249. Gonocarpus salsoloides", W33982 (Herb. Reichenbach fil.) (fl.)! Isotypi: *Sieber 249,* Fl. Novae Holl., HBG!, G (Herb. Deless, DC.)! K (Herb. Hook.)! LE!, M!, MEL 1003765!, MEL1003784!, PR!, S!, W (Herb. Bauer)! (fl.).] Steudel, Nom. Bot. 2 ed. 1 (1840) 700.

Haloragis salsoloides Benth., Fl. Aust. 2 (1864) 485 [Typus: "N.S. Wales. Port Jackson to the Blue Mountains, *R. Brown, Sieber,* n. 249, and others." Lectotypus (Orchard): *Sieber 249,* Fl. Novae Holl., K (Herb. Hook.) (fl.)! Isolectotypi: *Sieber 249,* Fl. Novae Holl., HBG!, G (Herb. Deless, DC.)!, LE!, M!, MEL1003765!, MEL1003784!, PR!, S!, W (Herb. Bauer, Rchbch.)! (fl.). Syntypi: *Anon s.n.,* NSW (examined Benth.), MEL39258 (fl.)!; *R. Brown s.n.,* Port Jackson, MEL39270 ex K (fl.)!; *R. Brown 4432,* 1802-5, Iter Australiense, K (Herb. Hook.)!, MEL39266 ex K! (fl., fr.)] F. v. M., Census 1 (1882) 50; F. v. M., Proc. Linn. Soc. N.S.W., 10 (1885) 197; F v. M., Trans. R. Soc. Vict. 24 (1888) 136; F. v. M., Sec. Census 1 (1889) 86; Moore, Hdbk. Fl. N.S.W. (1893) 185; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 31, 40; Schindler, Pflrch 23 (1905) 39; Dixon, Pl. N.S.W. (1906) 129; Britten, J. Bot. 45 (1907) 136; Maiden & Betche, Census N.S.W. Pl. (1916) 158; Evans, in Beadle et al., Hdbk. Vasc. Pl. Syd. Dist. (1963) 175; Praglowski, Grana 10 (1970) 172; Beadle et al., Fl. Syd. Reg. (1972) 207.

Figs.: Schindler, Pflrch 23 (1905) fig. 11E, F; Praglowski, Grana 10 (1970) pl. 4 (a-d).

Erect or ascending perennial herb, 15-40 cm tall, rootstock a simple taproot with adventitious roots from lower stems; profusely branched, stems red to green, ± unribbed, ± glabrous or sparsely appressed pilose with whitish, simple, uniseriate 1-2-celled hairs 0.1-0.2 mm long.

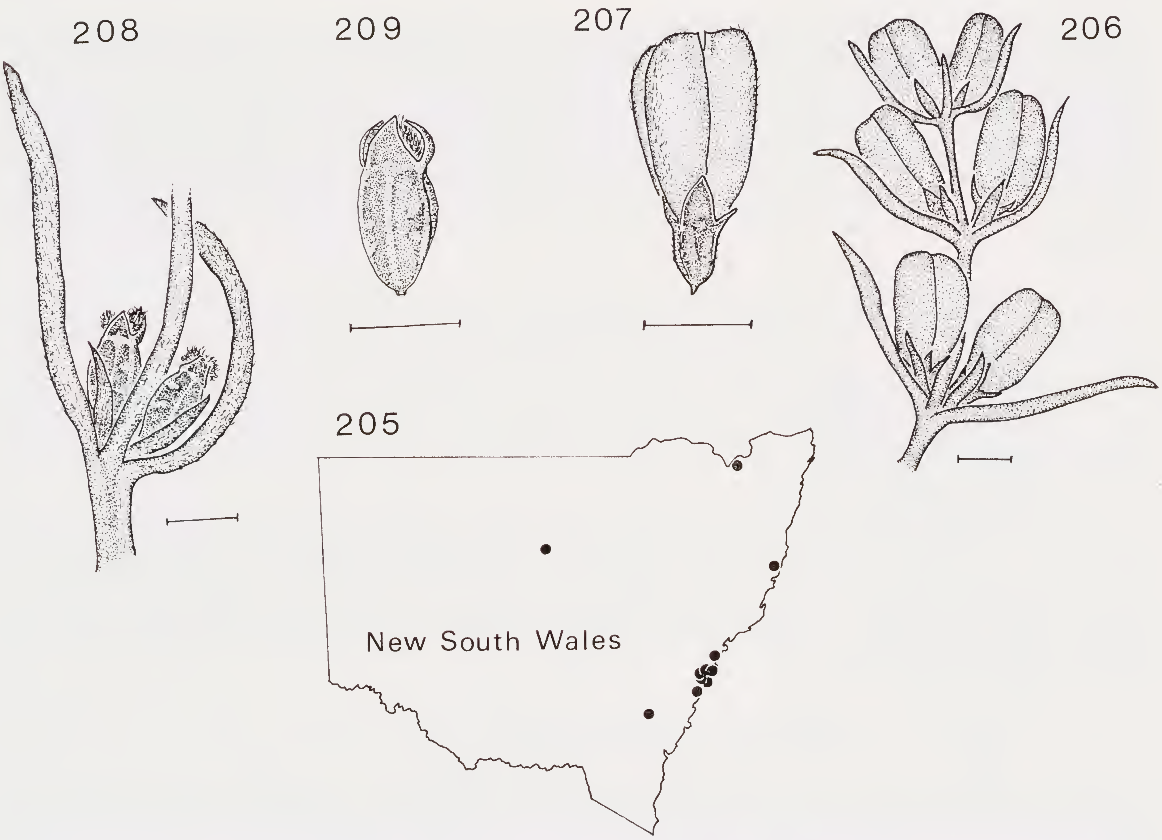
Leaves decussate, fleshy, linear to terete, 0.6-1.5 cm long, 0.5-2.0 mm wide, ± sessile, acute or submucronate, ± recurved, veins obscure, margin entire or very minutely 6-8-toothed near apex, glabrous or scabrous with hairs as for stems.

Inflorescence an indeterminate spike of flowers borne singly in axils of decussate primary bracts. Lateral inflorescences arise in axils of upper leaves. Primary bracts leaflike, linear, 2.0-5.5 mm long, 0.5-1.0 mm wide, sessile, acute, tip slightly reflexed, glabrous or scabrous. Secondary bracts fleshy, linear, 1.3-2.5 mm long, 0.5 mm wide, glabrous, or scabrous on margins (Fig. 206).

Flowers 4-merous, on pedicels 0.2-0.3 mm long (Fig. 207). Sepals 4, green or reddish, lanceolate-deltoid, 0.6-0.9 mm long, (0.3-) 0.4-0.5 mm wide, obtuse at tip, subcordate at base, ± smooth or with weak median basal callus, margins thickened, glabrous. Petals 4, red-brown to yellowish, hooded, keeled, non-unguiculate, (2.3-) 2.5-2.8 (-3.2) mm long, 0.5-0.7 mm wide (keel to margin), scabrous on keel. Stamens 8, filaments 0.2-0.3 mm long; anthers yellow, linear-oblong, (1.4-) 1.7-2.1 mm long, 0.3-0.4 mm wide, 4-celled, nonapiculate, antipetalous anthers ca 0.3 mm shorter than antisepalous ones. Styles 4, clavate, 0.3 mm long, stigmas capitate. Ovary green to red-grey, ovoid, 0.8-1.0 mm long, (0.3-) 0.5-0.8 mm wide, weakly 8-ribbed, sometimes with 2-3 weak oblique calluses between ribs, scabrous on ribs; incompletely 4-locular, 1 ovule per locule.

Fruit on pedicel 0.2-0.3 mm long, silver-grey, ovoid, 1.2-1.3 mm long, 0.8-0.9 mm wide, weakly 8-ribbed, with 2-3 weak oblique calluses between ribs, minutely and sparsely appressed scabrous on ribs; sepals persistent, erect, deltoid, 0.6-1.0 mm long, 0.5-0.8 mm wide, small deltoid median basal callus, margins thickened, glabrous; pericarp membranous, 1 seed (Figs. 208, 209).

Distribution: This species is confined to New South Wales, where it occurs in scattered localities on the eastern side of the Divide, from Clifton to Goulburn. The only inland locality represented in collections is Coolabah (Fig. 205).



Figs. 205-209. *Gonocarpus salsoloides*. 205. Distribution. 206. Tip of inflorescence. 207. Flower. (figs. 206, 207 from *McGillivray & Coveny 344*). 208. Base of infructescence. 209. Fruit (figs. 208, 209 from *Coveny s.n.*, NSW127199). Scales represent 1 mm (figs. 206-209).

Ecology: *G. salsoloides* appears to be confined to swampy areas, mainly at altitudes below 100 m. Collectors' notes include "sandhills . . . in moist places" (*Betche NSW99268*); 'in swamp" (*Cleland AD96905157*); "in swamp, on sandstone" (*Evans SYD*); "wet situations in damp sand" (*McBarron 17625*); "in swamp, in association with *Leptospermum liversidgei, Calorophus minor, Hibbertia salicifolia, Leptocarpus tenax, Sprengelia incarnata, Machaerina* sp. and *Blandfordia* sp." (*McGillivray & Coveny 344*); "on moist moory ground" (*Woolls MEL39265*). Flowering occurs from June to October and fruiting from July until January.

Specimens examined:

NEW SOUTH WALES: Anon s.n., N.S.W., MEL39258 (fl.) — syntype of *H. salsoloides; Betche s.n.,* -.ix.1883, Port Jackson, NSW99262 (fr.); *Betche s.n.,* -.vi.1894, sandhills near Randwick, NSW99268 (fl.); *Blakely & Shiress s.n.,* 22.viii.1926, Mount Pinary, Gosford, NSW99108 (fl., fr.); *Boorman s.n.,* -.vii.1897, Rose Bay, AD96905134, BRI080092 (fl., fr.); *Brown s.n.,* Port Jackson, MEL39270 (fl.) — syntype of *H. salsoloides; Brown 4432,* 1802-5, Iter Australiense, MEL, K (fl., fr.) — syntype of *H. salsoloides; Camfield s.n.,* 10.i.1897, Port Jackson district, M (fr.); *Camfield s.n.,* -.vii.1897, Port Jackson district, G (fr.); *Camfield s.n.,* -.x.1897, Port Jackson district, BISH, G, UPS (fr.); *Camfield s.n.,* 10.vii.1898, La Perouse road, AD96920057 (fr.); *Camfield s.n.,* -.viii.1900, Rose Bay, NSW99261, 99267 (fl., fr.); *Camfield s.n.,* -.viii.1906, Coolabah, G (st.); *Cleland s.n.,* -.xi.1912, Goulbourn ? (sic), AD96905132 (fr.); *Cleland s.n.,* 5.viii.1913, Long Bay, AD96905157 (fl.); *Coveny s.n.,* 26.viii.1967, North Head, N. of Quarantine Station, NSW127199 (fr.); *Day s.n.,* -.viii.1936, Bulli Pass, CANB10239 (fl.); *Evans s.n.,* -.vi.1925, Botany Bay district near Little Bay Hospital, SYD (fl.); *Fletcher s.n.,* 1.viii.1888, Waterfall-Clifton, AD96920058 (fl.); *Fletcher s.n.,* 18.viii.1888, Botany, AD96920056, 96920055, NSW99109 (fl.); *Forsyth s.n.,* -.x.1897, Port Jackson district, HBG (fl., fr.); *Haviland s.n.,* -.x.1885, Bondi, MEL39263, 39264 (fr.); *Lhotsky 175,* in Nova Hollandia, P (fl.); *Maiden s.n.,* -.ix.1897, Port Jackson district, AD96905133, MEL39261 (fr.); *Maiden s.n.,* -.viii.1900, Port Jackson district, CGE (fl.); *Mair s.n.,* 25.vii.1931, Curl Curl, CANB9027 (fl.); *McBarron 17622, 17625,* 25.viii.1969, Bull's Hill, S.W. of Woy Woy, NSW (fl., fr.); *McGillivray & Coveny 344,* 21.vii.1968, c. ¼ km N of Salt Water Lake c. 8 miles [13 km] N.N.E. of Port Macquarie, NSW (fl.); *Petrie s.n.,* Maroubra, MEL39257 (fl.); *Shirley s.n.,* National Park near Sydney, BRI080091 (fl.); *Sieber 249,* Fl. Novae Holl., G, HBG, K, LE, M, MEL, PR, S, W (fl.) — types of *G. salsoloides* and *H. salsoloides; Woolls s.n.,* -.vii.1885, Port Jackson, MEL39268 (fl.); *Woolls s.n.,* -.vii.1885, Double Bay, MEL39265, 39267, 39269 (fr.).

Bentham (1864) in describing *H. salsoloides,* placed in synonymy the name "Goniocarpus salsoloides Reichb. in Sieb. Pl. Exs., and in Steud. Nom. Bot. ed. 2". As pointed out by Britten (1907) both these references are to a *nomen nudum,* and do not constitute a direct or indirect reference to a previously published description. The name *H. salsoloides* must therefore be considered to be newly described in 1864 and must be attributed to Bentham. The name *Gonocarpus* ['*Goniocarpus*'] *salsoloides* however, was validly published by Sprengel in 1827, again based on Reichenbach's manuscript name. Bentham was apparently unaware of this, and there is no way of arriving at Sprengel's description from Bentham's references. Nor is a reference to Sprengel's description given in Index Kewensis, or later treatments of the species.

The type of *G. salsoloides* Rchbch. ex Sprengel must be assumed to be in the Reichenbach herbarium, and there is a *Sieber no. 249* duplicate there bearing the name *Goniocarpus salsoloides* in manuscript. This has been accepted as the holotype. Bentham's description of *H. salsoloides* was based on collections by "R. Brown, Sieber n. 249 and others", and the choice of a lectotype is thus required. As *G. salsoloides* and *H. salsoloides* have always been considered synonymous, it seems most useful to ensure that this continues by choosing the Sieber specimen as lectotype. Both names are thus based on the same collection (although different duplicates).

G. salsoloides is unique within the genus in that it shows pronounced evidence of being dioecious. Many plants with well-developed anthers have shrivelled or undeveloped ovaries, and do not seem to set fruit (e.g. *Camfield NSW99267, Sieber 249*). Other plants (e.g. *Camfield* G (herb. Pitard-Briau)) have well-developed fruits but have not been seen with flowers bearing functional anthers. Too few specimens exist in herbaria to judge whether dioecy is absolute in this species; field observations are needed to settle the question.

5. **Gonocarpus serpyllifolius** Hook. f. (Figs. 210, 211)

Gonocarpus serpyllifolius Hook. f., Ic. Pl. 3 (1840) tab. CCXC [Typus: "Common on open plains of the western parts of Van Dieman's Land, and on the Hampshire Hills. Ronald Gunn, Esq. (*n.* 257)". Holotypus: *Gunn 257,* -.ii.1837, H. Hills, K (Herb. Hook.) (fl., fr.)! — see below. Isotypus (?): *R. C. Gunn s.n.,* Hab. Tasmania, LE (ex Herb. Hook.) (fr.)! MEL39279 (fl., fr.)!] Nees in Lehm., Pl. Preiss. 1 (1844) 158.

Haloragis serpyllifolia (Hook. f.) Walp., Rep. 2 (1843) 99; Featon, Art Alb. N.Z. Fl. 1 (1889) 148; Curtis, Stud. Fl. Tas. 1 (1956) 188-189 p.p.

Haloragis depressa var. *serpyllifolia* (Hook. f.) Benth., Fl. Aust. 2 (1864) 485; Colenso, Trans. N.Z. Inst. 22 (1890) 463; Bailey, Qld. Fl. 2 (1900) 557; Schindler, Pflrch 23 (1905) 43; Cheeseman, Trans. N.Z. Inst. 42 (1909) 203.

Gonocarpus vernicosus Hook. f., Ic. Pl. 4 (1840) tab. CCCXI [Typus: "This was selected from other Van Dieman's Land plants with which it was found mixed". Holotypus: *R. Gunn 257,* 18.xii.1841, New Norfolk, K (Herb. Hook.)! — see below].

Haloragis vernicosa (Hook. f.) Walp., Rep. 2 (1843) 99.

Haloragis depressa non (A. Cunn.) Walp.: Rodway, Tas. Fl. (1903) 49 p.p.

Figs.: Hook. f., Ic. Pl. 3 (1840) tab. 240, 4 (1840) tab. 311.

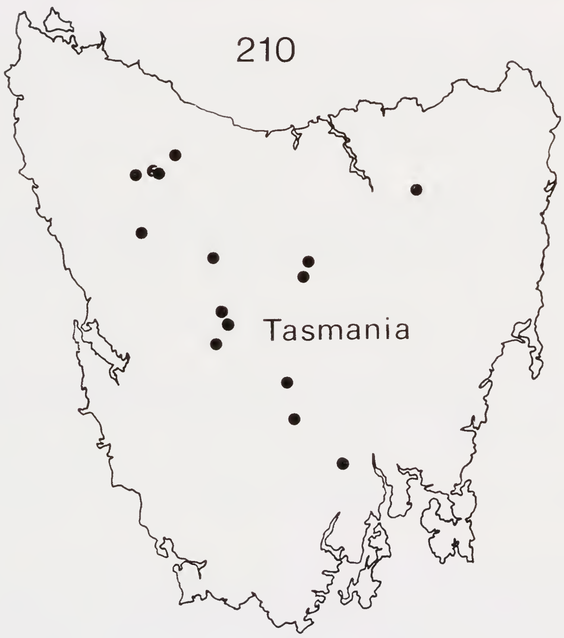
Erect or ascending perennial herb 10-25 cm tall, rootstock a simple taproot, stems rooting towards base, wiry, reddish, ± lacking ribs, all except older ones densely appressed pubescent with white 2-3-celled simple uniseriate hairs 0.2-0.3 mm long.

Leaves decussate, ± sessile or on petiole ca 1 mm long, leathery, lanceolate to ovate, 0.5-1.0 mm long, 0.2-0.3 (-0.6) mm wide, dark glossy green above, lighter and duller below, apex acute, base rounded, margins thickened, entire or serrate with 2-4 (-10) minute teeth 0.2-0.3 mm long, midrib channelled above, prominent below, lateral veins obscure, ± appressed scabrous on midrib of lower surface and petiole, otherwise glabrous (rarely, older leaves scabrous over entire lower surface).

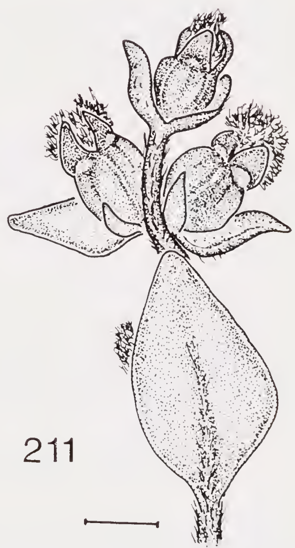
Inflorescence a spike of flowers borne singly in the axils of decussate primary bracts (sometimes becoming alternate towards tip), terminated by a single flower subtended by 2 primary bracts. Lateral inflorescences arise in axils of upper leaves. Primary bracts leaflike, ovate, 2.0-3.0 mm long, 1.0-1.4 mm wide, margin thickened, entire, sparsely scabrous on lower surface. Secondary bracts brown, membranous, narrow-lanceolate, 0.9 mm long, 0.4 mm wide, entire, weakly midribbed, scabrous (Fig. 211).

Flowers 4-merous, ± sessile. sepals 4, greenish, narrow-deltoid, 0.7-0.8 mm long, 0.5 mm wide, margins slightly thickened, weak median basal callus, glabrous. Petals 4, red, hooded, shortly unguiculate, keeled, 2.2-2.5 mm long, 0.4-0.5 mm wide (keel to margin), scabrous on keel. Stamens 8, filaments 0.2 mm long; anthers linear-oblong, 1.8-2.0 mm long, 0.3 mm wide, 4-celled, nonapiculate, antipetalous anthers ca 0.2 mm shorter than antisepalous ones. Styles 4, clavate, 0.3 mm long, stigmas reddish purple, densely fimbriate. Ovary reddish grey, glossy, ovoid, 1.0 mm long, 0.8 mm wide, strongly 4-ribbed opposite petals, weakly ribbed or ± smooth opposite sepals, lacking tubercles between ribs, glabrous; pericarp membranous, septa incomplete, 4 locules, 1 ovule per locule.

210



211



Figs. 210, 211. *Gonocarpus serpyllifolius.* 210. Distribution. 211. Tip of young infructescence (from *Burbidge 3307*). Scale represents 1 mm.

Fruit silvery, reddish-grey or metallic purple, ± sessile, ovoid, 1.0-1.3 mm long, 0.9-1.3 mm wide, glossy, weakly 4-8-ribbed, or almost smooth, lacking tubercles, glabrous; sepals persistent, erect, deltoid, 0.5-0.8 mm long, 0.5 mm wide, ± concave, weak median basal callus, slightly thickened margins, styles reflexed between; pericarp membranous, 1 seed.

DISTRIBUTION: With the exception of one collection, this species is confined to the central plateau of Tasmania, extending from near Waratah to New Norfolk. The exception is a plant from Bidwell, Victoria, which has most of the characters of the species, but differs in others. (Fig. 210). This is discussed below.

ECOLOGY: *G. serpyllifolius* is confined to open grassy areas in sclerophyll forest between about 300 m and 900 m altitude. Collectors' notes include "woodland along creek, herb in grassy sward below shrubs and trees" (*Burbidge 3307*); "open sclerophyll forest (cut over for papermills), herb amongst grasses" (*Burbidge 3492*); "cleared flat" (*Curtis CHR180360*). Flowering and fruiting occur from December until February.

SPECIMENS EXAMINED:

TASMANIA: Anon. 137, Hamp. Hills, MEL48222 (fr.); *Anon. s.n.,* 12.i.1960, Howes Run, Arm River, HO (fl.); *Archer s.n.,* Tasmania, NSW99075 (fr.); *Barber s.n.,* 8.ii.1945, Lake St. Clair, HO6694 (fl., fr.); *Burbidge 3307,* 24.i.1949, North of Ellendale, CANB (fl., fr.); *Burbidge 3492,* 31.i.1949, 9 miles [15 km] north of Waratah CANB (fl., fr.); *Curtis s.n.,* 14.ii.1948, Hellyer Gorge (Burnie-Waratah road), CHR180360, HO6691 (fl., fr.); *Davis & Davis s.n.,* 7.i.1937, Pieman R. bridge, NSW99074 (fr.); *Eichler 16654,* 15.i.1960, Lake St. Clair, AD (fl.); *Gunn s.n.,* Tasmania, LE, MEL39279 (fl., fr.) — ? isotype of *G. serpyllifolius*; *Gunn 257,* -.ii.1837, H. Hills, K (fl., fr.) — holotype of *G. serpyllifolius*; *Gunn 257,* 18.xii.1841, Glen Leith, AK, NSW (2 sheets) (fl., fr.); *Gunn 257,* 18.xii.1841, New Norfolk, K (fl., fr.) — holotype of *G. vernicosus*; *Gunn 257,* 1842, W. Mts., CGE (fr.); *Gunn 257,* 18.ii.1843, W. Mts., K (fl., fr.); *Gunn 257,* 13.ii.1845, Lake St. Clair, K (fl., fr.); *Milligan s.n.,* 15.xii.1841, Hampshire Hills, HO6698 (fr.); *Milligan 276,* Hampshire Hills, MEL39278 (fl., fr.); *Peterson s.n.,* -.ii.1953, Breona, at northern end of Great Lake, MEL39280 (fl., fr.); *Rodway s.n.,* -.ii.1894, Great Lake, HO6696b (fl., fr.); *Rodway s.n.,* -.xii.1917, River Dee, HO6654 p.p., NSW99073 (fl., fr.); *Rupp 46,* -.i.1922, Mt. Barrow, NSW (fr.); *Scott s.n.,* Tasmania, MEL1003705, 1003710 (fl.); *Simson s.n.,* 1876, Thomas's Plains, HO6695; *Simson 2316,* 1892, Tasmania, MEL1003677 (fr.); *Whaite & Whaite 2429,* 2.ii.1961, Lyell Highway 60 miles [100 km] from Queenstown, NSW (fr.). *VICTORIA: W. Hunter s.n.,* -.i.1941, Bidwell, MEL39281 (fl.).

The type sheet of *G. serpyllifolius* in K bears three different *Gunn 257* labels, from Hampshire Hills, Lake St. Clair and Western ["W"] Mountains. Only the first bears a date earlier than the date of publication. There are 8 specimens mounted on the sheet, all representing *G. serpyllifolius,* but the piece mounted directly above the H. Hills label is a very good match with the illustration accompanying Hooker's original description, and must be the type specimen. It is not possible to determine whether any of the other plants on the sheet are duplicates of the type or whether they all belong with the other labels.

Although Hooker did not mention a recognisable collection in his description of *G. vernicosus,* there is a sheet in his herbarium bearing this name, plus pencil sketches that eventually accompanied the description in Icones Plantarum (1840). There are two collections mounted on the sheet: the smaller one at the top of the sheet is a good match with Hooker's illustration and must be the holotype.

The Hunter collection from Victoria is puzzling. The flowers and bracts are a very good match with those of *G. serpyllifolius,* the inflorescence is determinate, with a terminal flower, and the type and distribution of the indumentum also agrees well. However, apart from the lowermost pair, the flowers are arranged alternately, and the leaves are duller and longer than is normal for the Tasmanian plants. For the present, Hunter's collection is referred to *G. serpyllifolius*, but more specimens are needed to clarify its position.

Functionally female flowers with abortive anthers occur occasionally (e.g. the type of *G. vernicosus*).

The relationships of *G. serpyllifolius* lie with *G. aggregatus,* from which it differs mainly in its non-swollen pericarp, and with *G. montanus,* from which it can be distinguished by its small size, determinate inflorescence, prominent styles and smoother fruit.

6. **Gonocarpus aggregatus** (Buchanan) Orchard (Figs. 212-219)

Gonocarpus aggregatus (Buchanan) Orchard, comb. nov.

Haloragis aggregata Buchanan, Trans. N.Z. Inst. 4 (1872) 224 [Typus: "H. H. Travers, near Lake Guyon, Nelson Province, February, 1871." Holotypus: "Type of H. aggregata Buch . . . Communicated by Mr Buchanan to me" scripsit Cheeseman, AK5937 (fr.)! Isotypi: *H. Travers s.n.*, Lake Guyon, AK5938 (fr.)!; *H. H. Travers s.n.*, 1871, subalpine (Mountains, Nelson), K (fr.)!; *H. H. Travers s.n.*, Lake Guyon, WELT40806 (herb. Kirk) (fr.)!]; Featon, Art Alb. N.Z. Fl. (1889) 149.

Haloragis uniflora Kirk, Trans. N.Z. Inst. 9 (1877) 548 [Typus: "South Island: the Bluff Hill, Southland". Holotypus: *T. Kirk s.n.*, The Bluff Hill, Southland, WELT40774 (fr.)!; Isotypi: *T. Kirk s.n.*, Bluff Hill, Southland, AK5942 p.p. (fr.)!; *T. Kirk s.n.*, 2.i.1877, Bluff Hill, WELT40772 (fr.)!; *T. Kirk s.n.*, The Bluff, CANTY 723 (fr.)!; *T. Kirk 373*, Bluff Hill, AD, CGE (fr.)!] Petersen, Pflfam. 3 (1893) 230; Kirk, Stud. Fl. N.Z. (1899) 149; Schindler, Pflrch 23 (1905) 43-44; Cockayne, Rep. Bot. Surv. Stewart Isl. (1909) 57.

Haloragis spicata Petrie, Trans. N.Z. Inst. 19 (1887) 325 [Typus: "Moist terraces, top of Lake Hawea, 1150 feet." Holotypus: *D. Petrie s.n.*, lower part of Hunter R., Lake Hawea, on gravelly terraces, WELT40784 (2 sheets) (fr.)!; Isotypi: *D. Petrie s.n.*, -.ii.1886, Hunter River, Lake Hawea, AK5939 (2 sheets) (fl., fr.)! *D. Petrie s.n.*, Hunter R., L. Hawea, WELT6882 (fr.)!; *D. Petrie s.n.*, Lake Hawea Flat, head of the Lake, WELT40817 (fr.)!; *D. Petrie s.n.*, lower part of Hunter R.,, Lake Hawea on gravelly terraces, WELT40822 (fr.)!; *D.P. s.n.*, Lake Hawea, WELTU2642 (fr.)!]; Kirk, Stud. Fl. N.Z. (1899) 149; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 40; Cheeseman, Trans. N.Z. Inst. 42 (1909) 203.

Haloragis bibracteolata Colenso, Trans. N.Z. Inst. 22 (1890) 462 [Typus: "Dry spots, sides of Mount Tongariro, County of East Taupo; 1889: Mr. H. Hill." Holotypus: Com. *W. Colenso 5/1890*, New Zealand 6/90, K (fr.)!]

Haloragis depressa var. *aggregata* (Buchanan) Kirk, Stud. Fl. N.Z. (1899) 149; Cheeseman, Man. N.Z. Fl. (1906) 149; Cheeseman, Man. N.Z. Fl. 2 ed. (1925) 622.

Haloragis uniflora var. α *genuina* Schindler, Pflrch 23 (1905) 44; Praglowski, Grana 10 (1970) 174.

Haloragis uniflora var. β *bibracteolata* (Colenso) Schindler, Pflrch 23 (1905) 44; Praglowski, Grana 10 (1970) 174.

Haloragis uniflora var ẟ *spicata* (Petrie) Schindler, Pflrch 23 (1905) 44.

Haloragis depressa var. *spicata* (Petrie) Cheeseman, Man. N.Z. Fl. 2 ed. (1925) 622.

Haloragis depressa auct. non (A. Cunn.) Walpers: Hook. f., Fl. N.Z. 1 (1852) 63; A. Gray, Bot. U.S. Expl. Exped. 1 (1854) 626; Hook. f., Handbk. N.Z. Fl. (1864) 65; Kirk, Trans. N.Z. Inst. 9 (1877) 548; Colenso, Trans. N.Z. Inst. 18 (1886) 260; Featon, Art Alb. N.Z. Fl. (1889) 148; Colenso, Trans. N.Z. Inst. 22 (1890) 463; Kirk, Stud. Fl. N.Z. (1899) 148, 149; Cheeseman, Man. N.Z. Fl. (1906) 149; Cheeseman, Trans. N.Z. Inst. 42 (1909) 202, 203; Cheeseman, Man. N.Z. Fl. 2 ed. (1925) 622; Cambie et al., N.Z. J. Sci. 4 (1961) 616; Allan, Fl. N.Z. 1 (1961) 244, 245; Praglowski, Grana 10 (1970) 174.

Haloragis depressa var. *serpyllifolia* auct. non (Hook. f.) Benth.: Kirk, Stud. Fl. N.Z. (1899) 149; Cheeseman, Man. N.Z. Fl. (1906) 149.

FIG.: Buchanan, Trans. N.Z. Inst. 4 (1872) Pl. XIII.

Slender erect or ascending perennial herb (2-) 4-10 (-25) cm tall, underground stems yellow, fleshy, with decussate deltoid bracts ca 1 mm long at nodes, aerial stems rooting at lower nodes, weakly 4-ribbed, younger parts moderately densely appressed or spreading pilose with white or transparent (1-) 2-3-celled simple hairs 0.2-0.5 mm long (Figs. 214-216).

Leaves decussate, on petioles 1-2 mm long, lamina ovate to narrow-ovate (rarely, lanceolate), (0.2-) 0.4-0.8 (-1.5) cm long, (0.15-) 0.4-0.8 (-1.0) cm wide, obtuse or ± acute at tip, rounded at base, margins thickened, serrate with (2-) 4-10 obliquely cuspidate teeth (0.5-) 1.0-1.5 mm long, dark green above, lighter below, midrib weakly channelled above, prominent below, lateral veins obscure, appressed pilose on both surfaces with hairs as for stems (rarely, ± glabrous).

Inflorescence a spike of flowers borne singly in the axils of opposite (rarely alternate) primary bracts, apparently terminated by a single flower (or sometimes 2 flowers) subtended by 2 primary bracts; on stunted plants sometimes only terminal flower present. Lateral inflorescences sometimes borne in the axils of the upper leaves. Primary bracts leaflike, lanceolate, (2.0-) 3.5-4.0 mm long, 1.5 mm wide, entire, weakly midribbed, scabrous on margins. Secondary bracts ± membranous, lanceolate, 0.5-1.2 mm long, 0.3-0.4 mm wide, entire, glabrous, or scabrous on margins (Figs. 217-219).

Flowers 4-merous, on pedicels 0.5 mm long. Sepals 4, green, lanceolate, 0.8-1.3 mm long, 0.5-0.7 mm wide, with median basal callus, otherwise smooth, glabrous. Petals 4, dark red, hooded, keeled, (1.7-) 2.2-2.7 mm long, 0.5-0.7 mm wide (keel to margin), scabrous on keel. Stamens 8, filaments 0.2 mm long; anthers yellow, linear-oblong (1.6-) 2.1-2.3 mm long, 0.3-0.4 mm wide, 4-celled, nonapiculate, antisepalous anthers ca 0.2 mm longer than antipetalous ones. Styles 4, yellow, clavate, 0.3-0.4 mm long, stigmas fimbriate. Ovary globose to turbinate, 1.0-1.3 mm long, 0.7-1.0 mm wide, 4-angled opposite petals, glabrous; septa incomplete, 4 ovules.

Fruits on pedicels 0.5-1.0 mm long, yellow-red to blackish, glossy, turbinate to globular, 1.5-2.0 mm long, (1.1-) 1.5-2.0 mm wide, strongly 4-ribbed between sepals, weakly ribbed or grooved opposite sepals, glabrous; sepals persistent, green, erect, narrow-deltoid to lanceolate, 0.7-1.0 (-1.3) mm long, 0.5-0.8 mm wide, styles reflexed between, weakly midribbed with faint median basal callus, sometimes two lateral calluses also, glabrous; exocarp swollen, spongy (rarely ± membranous), endocarp ± woody, 1 locule, 1 seed.

Figs. 212-219. *Gonocarpus aggregatus*. 212. Distribution. 213. Detailed distribution in New Zealand. 214-216. Habit (214 from *Petrie s.n.*, AK5939; 215 from *Travers s.n.*, AK5938; 216 from *Kirk s.n.*, AK5942). 217-219. Tips of infructescences (all from *Hynes s.n.*, AK104659). Scales represent 1 cm (figs. 214-216) or 1 mm (figs. 217-219).

Distribution: This species is confined to New Zealand (North, South and Stewart Islands) and the Chatham, Auckland and Campbell Islands. On the North Island its distribution follows the high country from the Aorangi Mts. and Rimutaka Range via the central plateau to Mt. Egmont and East Cape. Isolated records exist from Kariotahi, Mt. St. John (Auckland) and South Head, Kaipara Harbour. In the South Island, it is found throughout the length of the Southern Alps (Figs. 212, 213).

Ecology: *G. aggregatus* favours damp open localities, usually in bogs or alpine tussock. It is found almost exclusively above an altitude of 300 m. Collectors' notes include "damp sandy pasture near swamp" (*Allan CHR11353*); "forms sward in fine scree material" (*Baylis OTA001813*); "growing through *Sphagnum* bog" (*Burke WELTU2641*); "short tussock grassland" (*Connor & MacRae CHR194906*); "*Sphagnum* bog in tussock land" (*Druce CHR209647*); "bog edge at head of lake: stream margin" (*Given 67201*); "short turf between *Schoenus* tussocks; very wet soil" (*Macmillan & Chapman CHR 217751*); "occasional small diffuse cushions in open wet peaty areas among snow tussocks" (*Marks & Adams OTA023182*); "fixed sanddunes, east of lake" (*Moar 519*). Flowering occurs from November to February, and fruiting from about January until March, although specimens with fruits have been collected almost year round.

Specimens examined:

NORTH ISLAND: Allan s.n., -.ii.1929, Mt. Egmont, CHR1192 (fr.); *Aston s.n.*, Kaimanawa Range, WELT 40838 (fr.); *Aston s.n.*, -.i.1915, Kaimanawas, WELT6881 (fr.); *Aston 42*, Kaimanawa Mountains, AK (fr.); *Braggins s.n.*, 2.iii.1965, Mangetapopo Stream, Taurewa, WELTU6350 (fr.); *Burke s.n.*, 12.iii.1963, Napier-Taihape [? Taupo] road at Mangaohane turnoff, WELTU2638 (fr.); *Carse s.n.*, -.ii.1901, Kariotahi Gap, CANTY804, WELT40847 (fr.); *Carse s.n.*, -.i.1918, Waimarino Plain, CANTY805 (fr.); *Carse s.n.*, -.i.1921, Haunted Whare, slopes of Mt. Ruapehu, CANTY802 (fl., fr.); *Carse s.n.*, 22.xii.1923, Waimarino W., CANTY 803 (st.); *Carse & Matthews s.n.*, -.i.1918, Mt. Hauhungatahi, CANTY801 (fr.); *Cheeseman s.n.*, -.i.1895, Mangawhare, AK5930 (fr.); *Cooper s.n.*, 20.xi.1948, National Park, AK24034 (fr.); *Cranwell s.n.*, 17.i.1934, Mt. Egmont, AK100962 (fr.); *Druce DEG203*, 8.i.1948, N.W. Ruahines, CHR (st.); *Druce DEG204*, 11.i.1948, Otupae Range, CHR (fr.); *Druce s.n.*, -.ii.1956, Mokai Patea, Ruahine Ra., CHR86444 (fr.); *Druce s.n.*, -.ii.1960, Pouakai Ra., CHR86738 (fr.); *Druce s.n.*, -.xi.1962, Mt. Egmont, Cultivated Taita, CHR129996 (fl., fr.); *Druce s.n.*, -.xi.1962, Egmont, CHR129797 (fr.); *Druce s.n.*, -.ii.1968, Ngapehi-o-waikareiti, CHR180695 (fr.); *Druce s.n.*, -.i.1970, Mangatoetoe, Aorangi Ra., CHR197366 (fl.); *Druce s.n.*, -.iii.1970, Kaiparoro, Tararua Ra., CHR209647 (fr.); *Druce s.n.*, -.xii.1970, Ahuateatha, Maungaharuru Ra., CHR216795 (fr.); *Druce s.n.*, -.xii.1970, Tikiokura, Maungaharuru Ra., CHR216984 (fl., fr.); *Druce s.n.*, -.ii.1971, S. Ruahine Ra., CHR210236 (fr.); *Hamlin s.n.*, 18.i.1950, Pureora, Maraeroa Plains near Mangapehi, CHR68620 (fl., fr.); *Hamlin 848*, 20.ii.1958, The Swamp, between Mt. Egmont & Pouakai Range, WELT5004 (st.); *Healy s.n.*, 3.i.1941, National Park, CHR33220 (fr.); *Hynes s.n.*, -.i.1954, Mt. Ruapehu, AK50537 (fr.); *Hynes s.n.*, 22.i.1958, near Manganui Hut, Mt. Egmont, AK50833 (fl., fr.); *Hynes s.n.*, 31.i.1960, Pureora State Forest, AK62047 (fr.); *Kirk s.n.*, Opepe near Taupo, AK5940, OTA015940, WELT40808 (fr.); *Kirk s.n.*, -.ii.1872, Motukino, Taupo, AK5941, WELT 40803 (fr.); *Matthews s.n.*, Waimarino, AK100930 (fl., fr.); *Matthews s.n.*, 14.i.1920, Te Whaiti, AK100929 (st.); *Meebold 4911*, -.vii.1929, Poketitiri, Kaweka Range, M (fr.); *Meebold 18237*, -.ii.1933, Ohakune, M (fr.); *Meebold 18238*, -.ii.1933, Ruapehu, M (fr.); *Meebold 18240*, -.ii.1933, Waipunga Bush, Taupo road, M (fr.); *Moar 519*, 31.i.1950, Wilsons Lake, South Head, Kaipara Harbour, CHR (fr.); *Moar 536*, 31.i.1950, sanddunes between Wilsons Lake and road, South Head, Kaipara Harbour, CHR (fr.); *Moore s.n.*, 29.xii.1954, Mount Egmont track, Dawson Falls to plateau, CHR87711 (fr.); *Moore s.n.*, 30.xii.1954, Hooker Hut, Mt. Egmont, CHR87712 (fl.); *Moore s.n.*, 2.iv.1956, Waihohonu, National Park, CHR87844 (st. — terat.); *Nelson 21431*, Ruapehu, M (fr.); *Oliver s.n.*, 2.i.1937, Dawson Falls, Mt. Egmont, WELT6883 (st.); *Oliver s.n.*, 22.i.1954, Waimarino, WELT39452 (fr.); *Orchard 3312*, 23.v.1972, Silica Springs Track, Tongariro National Park, AK (fr.); *Petrie s.n.*, -.i.1897, Mangatote, Waiapu River, WELT40852 (fr.); *Petrie s.n.*, -.i.1897, Waipiro, AK5931 (fr.); *Petrie s.n.*, -.i.1897, Jerusalem (Hirukaramu) near Waipiro Bay, WELT40849 (fr.); *Petrie s.n.*, 6.ii.1901, Mt. Egmont, WELT40848 (fl, fr.); *Petrie s.n.*, -.xi.1908, Tiroa, E. from Mangapeehi, WELT40832 (fl., fr.); *Petrie s.n.*, 4.ii.1909, Rimanga, nr. Napier-Taupo road, WELT40836 (fr.); *Petrie s.n.*, -.i.1917, Waimarino plain, WELT40842 (fr.); *Petrie s.n.*, -.xii.1919, lagoon on Mt. St. John, Auckland, AK130042 (fr.); *Petrie s.n.*, -.i.1920, Te Whaiti, WELT40835 (st.); *Petrie s.n.*, -.iii.1921, Waimarino, CHR11351, WELT40841, 40843 (fr.); *Petrie 42*, -.i.1915, Kaimanawas, WELT40788 (fr.); *Phillips-Turner 244*, Pokaka, National Park, AK (fr.); *Poole s.n.*, 14.i.1950, near Timahanga shearing sheds, Inland Patea, Rangitikei, CHR68852 (fr.); *Tryon s.n.*, Mt. Tauhara-Taupo, BRI079994 (fr.); *Zotov s.n.*, 10.iii.1931, Ruahine-Cook, CHR2517 (fr.); *Zotov s.n.*, 31.i.1932, Mangatainoka, CHR4278 (st.); *Zotov s.n.*, 31.xii.1943, Ruahine Mts, Reporoa Bay, CHR41577 (fr.); *Zotov s.n.*, 15.i.1946, summit of Haukura III, Tararua Range, CHR54307 (terat.). *SOUTH ISLAND: Adams s.n.*, Mt. Arthur, AK15118 (fr.); *Adams s.n.*, Mt. Cook, AK15119 (fr.); *Allan s.n.*, Ashburton R., CHR11353, 11329 (fr.); *Allan s.n.*, -.xi.1936, Balclutha, CHR17631 (fr.); *Allan s.n.*, 19.ii.1943, Awatere River, near Molesworth Homestead, CHR92807 (fr.); *Allan s.n.*, 30.iii.1945, Molesworth, CHR51268 (fr.); *Allan s.n.*, 22.i.1946, Bluff Hill, CHR54319 (fr.); *Armstrong s.n.*, 1867, Buller Gorge, CANTY (fr.); *Aston s.n.*, 25.xii.1895, Bluff Hill, WELT40775 (fr.); *Aston s.n.*, -.i.1909, Bluff Hill, WELT40837 (fr.); *Baylis s.n.*, 31.i.1947, Upper Copland Valley, OTA001813 (fr.); *Brockie s.n.*, 28.ii.1937, Arthurs Pass, CHR223800 (fl., fr.); *Brockie s.n.*, 8.i.1945, Ada Pass Saddle, Spenser Mts., CHR221681 (fl.); *Burke s.n.*, 12.iv.1963, Mt. Arthur, WELTU2641 (fr.); *Burnett 133*, 7.i.1962, Dart Valley, OTA007047 (fr.); *Burrows s.n.*, -.i.1954, Hoophorn Ridge, Ben Ohau Rd., CANU3178 (fr.); *Burrows s.n.*, -.i.1957, Nigger Ck., Esk R., CANU3173 (fr.); *Burrows s.n.*, -.i.1962, Takahe Valley, CANU5659 (fr.); *Calder s.n.*, 3.xii.1956, Cass, CANU7380 (fl.); *Cheeseman s.n.*, -.i.1878, Wairau Valley, AK5933 (fl., fr.); *Cockayne s.n.*, -.i.1896, trib. of Broken R., WELT40851 (fr.); *Colenso s.n.*, -.v.1890, s. loc., K (fr.) — holotype of *H. bibracteolata; Collett s.n.*, -.iv.1965, Kahurangi Point, CHR177505 (fr.); *Collett s.n.*, 13.viii.1969, Glentamer Station, Ben Ohau Range, CHR194912 (fr.); *Cone s.n.*, 6.i.1955, Franz Josef, CHR87371, 87386 (fr.); *Connor s.n.*, -.ii.1958, Red Lake,

Sebastopol, CHR108225 (fl., fr.); *Connor s.n.*, 26.ii.1958, Black Birch Stream to Red Lake, CHR98368 (fl., fr.); *Connor s.n.*, 14.i.1961, Godley River near Sibbald's Islands, CHR122516 (st.); *Connor & MacRae s.n.*, 19 xii.1962, Jacks Stream fan, Ferintosh, Lake Pukaki, CHR194906 (fr.); *Connor & MacRae s.n.*, 15.ii.1963, Rose Hill near Methven, CHR173302 (fr.); *Cranwell & Moore s.n.*, 12.i.1940, Table Hill Track, Stewart Island, CHR24186 (fr.); *Dobson s.n.*, 22.i.1971, Lewis Pass, CANU014568 (fl., fr.); *Dobson s.n.*, 21.xii.1972, Lake Heron, CANU018717 (fr.); *Druce s.n.*, -.xi.1971, Wharariki Beach, W. of Cape Farewell, CHR245169 (fl.); *Fineran s.n.*, -.i.1961, Port Pegasus, Stewart Island, CANU7210 (st.); *Gibbs s.n.*, Cobb Valley, AK5935, 5936, CHR 117724, 117723 (fr.); *Given 64152*, 14.ii.1964, Cross Ck., near Haast Pass, CHR (st. — terat.); *Given 67201*, -.i.1967, Lake Mike, Dusky Sound, CHR (fl., fr.); *Haast s.n.*, Canterbury Plains, WELT40812 (fr.); *Hair s.n.*, 26.v.1955, Eglinton Valley, CHR87622 (st.); *Harris s.n.*, 6.iii.1949, Arthurs Pass, CHR79857 (fr.); *Hay s.n.*, 12.iv.1952, Peel Lake, Mt. Peel, CHR75539 (fr.); *Healy 61/164*, 3.ii.1961, Hokitika, CHR (fr. — terat.); *Healy 69/269*, 1.iii.1969, Milton cemetery, CHR (fr.); *Hector s.n.*, Dunedin, WELT40819 (fr.); *Holloway s.n.*, Flagstaff, OTA001812 (fr.); *Hynes s.n.*, 12.i.1959, Haast Pass, AK58868-9 (fr.); *Hynes s.n.*, 16.ii.1963, Ringaringa Point, Stewart Island, AK92255 (fr.); *Hynes s.n.*, 18.i.1965, Hooker Valley, near Hermitage, AK104659 (fr.); *Hynes s.n.*, 1.iii.1969, Key Summit, Eglinton Valley, AK120333 (fr.); *Johnson s.n.*, 12.i.1970, near Buncrana Is., Lake Manapouri, OTA028490 (fr.); *Johnson s.n.*, 23.i.1970, Hope Arm, Manapouri, OTA028554 (st.); *Johnson s.n.*, 20.v.1971, Sandfly Point, head of Lake Te Anau, OTA031123 (st.); *Kirk s.n.*, Bluff Hill, AD96906038, AK5942, CANTY723, CGE, WELT40772, 40774 (fr.) — types of *H. uniflora*; *Kirk s.n.*, Bluff Harbour, WELT40773 (fr.); *Kirk s.n.*, The Bluff, OTA015942, WELT40850 (fr.); *Kirk s.n.*, Canterbury Plains, AK11475 (fr.); *Kirk s.n.*, Mt. Spenser, AD96906017 (fr.); *Kirk s.n.*, -.i.1875, Lake Rotoiti, AK5934, OTA015926, WELT40313 (fl., fr.); *Kirk s.n.*, 27.xii.1876, Owaka River, WELT40811 (fr.); *Kirk s.n.*, -.i.1890, Dunedin, WELT40805 (fr.); *Laing s.n.*, Cameron River, CANU3182 (st.); *Laing s.n.*, -.i.1925, Jack's Huts, Arthurs Pass, CANTY (fr.); *Laing s.n.*, -.i.1928, top of Arthurs Pass, CANTY (st.); *Lister s.n.*, 10.ii.1889, Hermitage, Mt. Cook, CGE (fr.); *Lloyd s.n.*, 17.xii.1957, Woolshed, Cass, CANU3126 (fr.); *Mackay s.n.*, 9.i.1927, Croesus Track, north of Greymouth, CHR60224 (fr.); *Macmillan s.n.*, 3.vi.1962, Mt. Cook Station, S. Liebig Range, CHR193894 (fr.); *Macmillan & Chapman s.n.*, 19.xii.1970, Lake Pukaki, CHR217751 p.p. (fr.); *Macmillan & Mitchell s.n.*, 3.iii.1970, Irishman Creek Stn., Lake Pukaki, CHR206696 (st. — terat.); *Mark s.n.*, 22.v.1967, Mt. Burns, Hunter Mts., OTA018970 (st.); *Mark s.n.*, 19.i.1969, Mueller Valley, Turnbull River, OTA024066 (fl., fr.); *Mark s.n.*, 8.ii.1969, Howe Ck., Burke Valley, OTA028762 (fr.); *Mark s.n.*, 15.i.1970, Swampy Summit, Dunedin, OTA 028772 (fl., fr.); *Mark & Adams s.n.*, 7.i.1968, Borland Saddle, Hunter Mts, OTA023182 (fl.); *Mason s.n.*, 16.i.1941, Salisbury's Opening, Tasman Mountains, CHR28953 (fl.); *Mason 5750*, 13.iv.1958, Ashley Bridge, Canterbury, CHR (fr.); *Mason 8119*, 3.i.1961, Ferguson Creek, Hunter Valley, CHR (fr.); *Mason & Moar 1228*, 21.ii.1952, Awarua Bay, CHR (fr.); *Mason & Moar 1947*, 27.i.1953, Fairdown ½ mile [1 km] north railway station, CHR (fr.); *Mason & Moar 2090*, 29.i.1953, Fairdown, between railway and road, south of Deadman's Creek, CHR (fr.); *Mason & Moar 5004*, 26.ii.1957, Lake Rotoiti near outlet, CHR (fr.); *Mason & Moar 5227*, 13.ii.1958, Lower Kokatahi Valley, CHR (fr.); *Mason & Moar 5328*, 17.ii.1958, south of Lake Mapourika, CHR (fr.); *Mason & Moar 5527*, 21.ii.1958, near Okarito Forks, CHR (fr.); *Mason & Simpson 3357*, 14.xii.1955, Cave Creek, Broken River Basin, CHR (st.); *Meebold 18239*, -.i.1933, Salisbury, Arthurs Plateau, M (fr.); *Meebold 21446*, -.ii.1936, Franz Josef Glacier, M (fl.); *Melville 6019*, 14.i.1962, foot of Mt. Peel, CHR (fr.); *Melville 6369*, 17.ii.1962, Mt. Anglem, Stewart Island, CHR (fr.); *Melville et al. 6205*, 30.i.1962, Potts River Bridge, CHR (fr.); *Mitchell & Macmillan s.n.*, 7.xi.1969, Braemar Station, Lake Pukaki, CHR206615 (fr.); *Moar 751*, 3.iv.1955, Chalk Hill, Oxford, CHR (fr.); *Molloy s.n.*, 12.xii.1969, Bankside Reserve, CHR201461 (fr.); *Moore s.n.*, 11.iii.1956, Acheron, CHR95636 (st.); *Moore s.n.*, -.i.1957, Milford Sound, CHR124146 (st.); *Moore s.n.*, -.iv.1963, Hanlings Lake, Milford Sound Track, HO6697 (fr.); *Murdoch s.n.*, 1910, Mason Bay, Stewart Island, WELT40846 (fl., fr.); *Oliver s.n.*, 27.i.1928, Bealey Valley, Ruin Bed, WELT6880 (fl., fr.); *Oliver s.n.*, 27.i.1928, Grahams Flat, Bealey Valley, WELT40819 (fl., fr.); *Oliver s.n.*, 28.i.1928, Arthurs Pass, WELT 40818 (fr.); *Oliver s.n.*, 31.xii.1944, Upper Hollyford Valley, WELT6869 (st.); *Oliver s.n.*, -.ii.1946, Salisbury Tableland, WELT6870 (fr. — terat.); *Oliver s.n.*, 7.i.1951, Weldcome, WELT6875, 6876 (fr.); *Oliver s.n.*, 17.i.1951, Waiho Valley, WELT6874 (fr.); *Oliver s.n.*, 27.i.1951, Waiho Valley, WELT6872, 6873 (fr.); *Petrie s.n.*, Lake Hawea, AK5939, WELT6882, 40784, 40817, 40822, WELTU2642 (fr.) — type of *H. spicata*; *Petrie s.n.*, Eastern Otago, WELT40776, 40844 (fl., fr.); *Petrie s.n.*, -.xi.1889, Dunedin, WELT 40807 (fl., fr.); *Petrie s.n.*, -.xii.1890, Dunedin, WELT40809, 40839, 40840 (fr.); *Petrie s.n.*, -.xi.1892, Eweburn Creek, WELT40833 (fl., fr.); *Petrie s.n.*, -.xii.1892, Dunedin, AK5942 p.p., WELT40845 (fl., fr.); *Petrie s.n.*, 30.xii.1912, Takitimo Mts, CANU3180 (fl., fr.); *Philipson s.n.*, 9.i.1957, Hawden River, under Woolshed Hill, Cass, CANU280 (fl., fr.); *Philipson s.n.*, 19.v.1957, east shore Lake Sarah, Cass, CANU279 (st.); *Prickett s.n.*, 19.ii.1959, Tasman Valley, Mt. Cook, CHR93823 (fr.); *Rawson s.n.*, 12.xii.1954/9.ii.1955, entrance to Native Rock Garden, Botanic Gardens, Christchurch, CHR92806 (fl., fr.); *Schweinfurth 717*, 23.ii.1959, Crooked Reach E. of Frazer Peaks, Stewart Island, M (fr.); *Simpson s.n.*, Flagstaff, OTA03398 (fr.); *Simpson s.n.*, -.vi.1935, Waitati, Dunedin, CHR17540, 18755 (fr.); *Simpson 322*, 1.i.1959, Travers Valley, CHR (fr.); *Simpson 3275*, 24.i.1962, Cupola Ck., Travers Valley, CHR (fr.); *Simpson 4376*, 30.iii.1965, upper d'Urville River, CHR (fr.); *Sykes 533/70*, 30.x.1970, Ward Beach, CHR (fr.); *Thomson s.n.*, -.i.1875, Wilson's Bay, Stewart Island, CANU3186 (fr.); *Thomson s.n.*, -.ii.1875, Brighton Creek, CANU3181 (fr.); *Thomson s.n.*, -.i.1878, nr. Dunedin, BRI080137 (fr.); *Travers s.n.*, Lake Guyon, AK5937, 5938, K, WELT40806 (fr.) — type of *H. aggregata*; *Wardle & Fryer s.n.*, 9.xii.1967, Karangarua River, CHR179192 (fl., fr.); *Wardle & Fryer s.n.*, 20.vii.1968, near Peters Pool, Waiho Valley, CHR185612 (fr.); *Wardle & Fryer s.n.*, 26.iii.1969, Tame Duck Flat, Karangarua River, CHR191912 (fr.); *Willa 7*, 5.ii.1960, Stewart Island, CHR (fr.); *Wilson 223*, -.i.1967, Hermitage, Hooker Valley, CHR (fl.); *Wood s.n.*, -.xii.1950, Lower Hollyford, AK100928 (fr.); *Woods s.n.*, -.ii.1959, Hermitage, Mt. Cook, AK118829 (fr.); *Zotov s.n.*, 5.i.1936, Dart River, CHR9990 p.p. (fr.); *Zotov s.n.*, 21.ii.1943, Mt. Blimit, CHR25298 (fr.). *CHATHAM ISLAND: Druce s.n.*, -.iii.1970, Te Whangu Lagoon (cultivated Taita, New Zealand), CHR197373 (fr.). *AUCKLAND ISLANDS: Johnson s.n.*, 5.ii.1973, Hooker Hills, Auckland Is., OTA033119 (fr.); *Johnson s.n.*, 11.ii.1973, above Magnetic Survey Cove, Adams Is., OTA033121 (fl.); *Johnson s.n.*, 20.ii.1973, Skua Gull Flat, behind Camp Cove, Auckland Is., OTA033118 (fl., fr.); *Johnson s.n.*, 23.ii.1973, Hanfield Inlet, Auckland Is., OTA033120 (fr.). *CAMPBELL ISLAND: Brockie s.n.*, 22.xii.1946, peat bog above Camp Cove, WELT40800 (fr.); *Godley s.n.*, 27.i.1961, Camp Cove, CHR118031 (fr.); *Muerk s.n.*, 7.ii.1970, east of Moubray Castle, CANU13069 (fr.); *Mitchell s.n.*, 1942, Campbell Island, CHR231609 (fr.); *Sorensen s.n.*, 19.ii.1946, Garden Cove,

CHR226290, 231608 (fr.); *Sorensen s.n.*, 18.iii.1947, Garden Cove, WELT40802 (st.); *Sorensen s.n.*, 22.iii.1947, Tucker Cove, WELT40801 (fr.).

This is a polymorphic species that consequently has acquired a complicated synonymy. Most authors have placed it under the name *Haloragis depressa* (A. Cunn.) Walp., but examination of Cunningham's type specimen revealed that this is *Gonocarpus micranthus*, at least in so far as it is recognisable. Cunningham's description "foliis . . . ramulisque scabriusculis . . ." does not agree with the specimen. It seems possible that Cunningham intended to describe a prostrate form of what is now *G. incanus* and inadvertently collected *G. micranthus* that was growing with it, consequently confusing the two in his description. The words "foliis elliptico-ovatis acutis crenatis . . . spicis elongatis laxis, floribus . . . patulis" could well refer to *G. micranthus*. The type locality, W[h]angaroa, is ca 250 km from the next most northern collection locality of *G. aggregatus*, and even this plant, from South Kaipara Head, is an anomalous outlier.

If Cunningham's plant is *G. micranthus*, then the earliest available epithet for the plant described above is *aggregata*. However Moore, in Allan (1961) suggested that *H. aggregata* Buchanan was based on a monstrosity and should be rejected. There is no doubt that this is the case with *H. spicata* Petrie (Fig. 214), also discussed by Moore, but the situation with *H. aggregata* (Fig. 215) is not so clear. The only abnormal aspect of the type specimen is the pronounced clustering of the fruits near the apex of the infructescence. This is the result of shorter than normal internodes, but there is no sign of overt disease, and the fruits seem to be perfectly normal. The degree of abnormality seems to me insufficient to justify rejection of the epithet *aggregata* on the grounds that it is based on a monstrosity. *G. aggregatus* was included in *H. depressa* var. *serpyllifolia* (Hook. f.) Benth. by Kirk (1899) and Cheeseman (1906). However, this latter plant, while undoubtedly closely allied to *G. aggregatus*, differs in its glabrous leaves, smaller, shining metallic fruits lacking a swollen pericarp, and more numerous flowers in the inflorescence. It is confined to Tasmania and treated under the name *Gonocarpus serpyllifolius* in this monograph.

The inflorescence of *G. aggregatus* is usually terminated by a single flower, a feature shared (within the genus) only with *G. serpyllifolius*. The swollen pericarp of the fruits is not found elsewhere in *Gonocarpus*, but does occur occasionally in *Haloragis*, *Haloragodendron* and *Glischrocaryon*.

As in many other species, some collections of *G. aggregatus* have functionally female flowers, with abortive anthers. Examples are *Connor CHR108225, Hay CHR75539* and *Lister s.n.*, CGE. This phenomenon was noted by Moore in Allan (1961).

Occasional plants have been noted (e.g. *Muerk CANU13069, Fineran CANU7210*) that are completely glabrous, but there is no pattern to their distribution, and other plants from the same localities have a normal indumentum.

7. **Gonocarpus sanguineus** (Merr. & Perry) Orchard (Figs. 220-222)

Gonocarpus sanguineus (Merr. & Perry) Orchard, comb. nov.

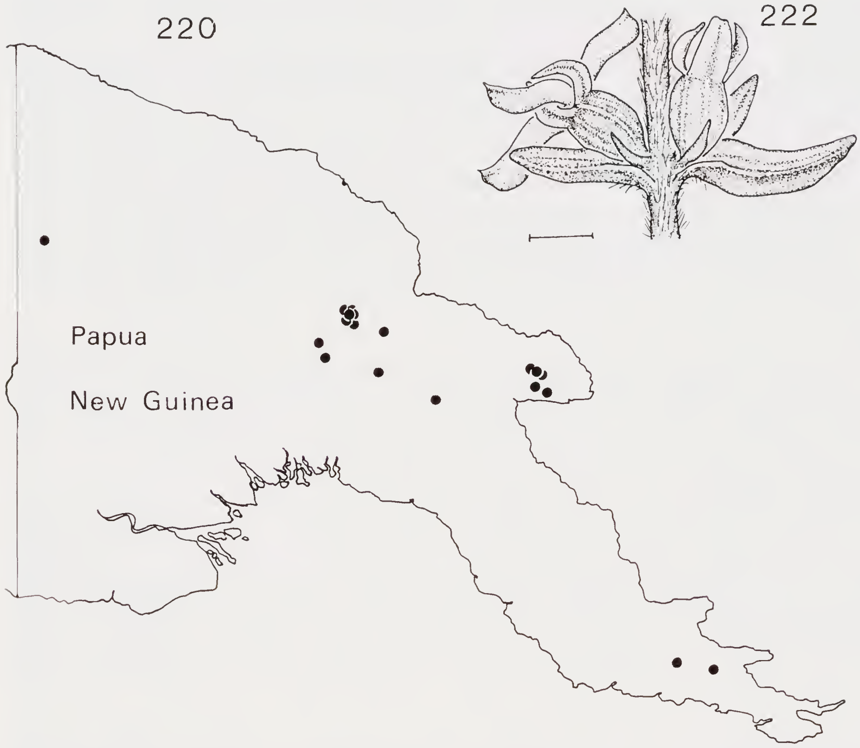
Haloragis sanguinea Merrill & Perry, J. Arn. Arb. 29 (1948) 162 [Typus: "North Eastern New Guinea: Matap, *Clemens 11345*, February-April 1940, alt. 1500-1800 m. (shrub; flowers dull sanguine colour)" Holotypus: A (fl.)!]

Haloragis microphylla Hoogland, Blumea Suppl. 4 (1958) 229 [Typus: "*Hoogland and Pullen 5631*, near Lake Aunde, E. slope of Mount Wilhelm, Bismarck Range, Terr. of New Guinea (Eastern Highlands District); common on forest (= shrubbery) - grassland edge; alt. ca. 3500 m. (11,700 ft.), collected 18 July 1956". Holotypus: CANB (fl.)! Isotypi: LAE, L, A, BM, BRI!, US!, MEL, K, G!, BO, PNH!, BISH!] Wade & McVean, Publ. Research School Pac. Stud. A.N.U. BG/1 (1969) 97 et seq.

Shrub or small tree (½-) 1-2 (-4) m tall, densely branched, stems dark reddish-brown, ± 6-angled, striate, densely spreading pubescent with simple transparent 2-4-celled hairs 0.3-0.5 mm long.

Leaves closely packed, verticillate in whorls of 3, on petioles 0.3-0.7 mm long, coriaceous, lanceolate, 3.0-5.0 mm long, (1.0-) 1.5-2.2 mm wide, margins thickened, almost entire or up to 4 small serrations, apex acute, base obtuse, midrib deeply sunken above, prominent below, lateral veins not apparent, upper surface glabrous (± pilose on larger leaves on old, non-flowering branches), extremely glossy light green, lower surface duller, pilose only on midrib with hairs as for stems.

Inflorescence an indeterminate spike of flowers borne singly in the axils of primary bracts and subtended by two secondary bracts; the fertile portion of the flowering branchlets usually unbranched. Unbranched lateral inflorescences arise in the axils of the upper leaves (Fig. 221). Primary bracts leaf-like, green, fleshy, petiolate, lanceolate, 3.0-3.5 mm long, 1.3-1.5 mm wide, entire or 1-2 serrulate, glabrous and glossy above with sunken midrib, pilose on prominent midrib below, arranged in whorls of 3 at least in lower part, but more widely spaced than sterile leaves. Secondary bracts linear-lanceolate, 0.6-0.8 mm long, 0.2-0.3 mm wide, 2- serrulate near base, sessile, ± fleshy, midrib faint, glabrous.



Figs. 220-222. *Gonocarpus sanguineus*. 220. Distribution. 221. Inflorescence. 222. Basal portion of young infructescence. (figs. 221, 222 from *Hoogland & Pullen 5631*). Scales represent 1 cm (fig. 221) or 1 mm (fig. 222).

Flowers tetramerous, reddish, all developing to anthesis, on peduncles 0.5-1.0 mm long. Sepals 4, green or reddish, ovate, weakly mid-ribbed, median basal callus, 0.8-1.1 mm long, 0.7-1.1 mm wide, glabrous. Petals 4, red to yellowish, hooded, tip hooked, non-unguiculate, (2.1-) 2.6-3.0 mm long, 0.7-1.0 mm wide (keel to margin), pilose with simple 2-3-celled hairs 0.2-0.3 mm long on keel. Stamens 8, filaments 0.1 mm long; anthers yellow or red, oblong, (1.5-) 1.8-2.0 mm long, 0.4-0.5 mm wide, 4-celled, equisized, nonapiculate. Styles 4, clavate, 0.3-0.4 mm long, stigmas globular, yellow-orange, fimbriate. Ovary orbicular to turbinate or ovoid, 1.0 mm long, 1.0 mm wide, ± 4-angled opposite petals, 8-ribbed, ± glabrous, sometimes pilose (and tuberculate) on ribs, 1-locular (4 septa at extreme apex only), 4 pendulous ovules.

Fruit on peduncle 1.0 mm long, ovoid, 1.0 mm long, 0.9-1.0 mm wide, ± 4-angled, 8-ribbed, ± glabrous or pilose (and tuberculate) on ribs only, sepals persistent, enclosing the styles or spreading, 0.9-1.1 mm long, (0.6-) 0.9-1.1 mm wide (Fig. 222). Solitary seed occupies entire fruit.

Distribution: *G. sanguineus* is confined to the highlands of Papua New Guinea (Fig. 220).

Ecology: This species favours open grasslands or the shrub boundary of the upper tree line, within the altitudinal limit 2230-4000 m. Collectors' notes include "common in long-grass community of alpine grassland" (*Brass 29802*); "in shelter of rocks in an exposed stone field" (*Brass 30112*); "gregarious on edges of *Equisetum-Carex* bog in forest" (*Brass 30542*); "in tussock grassland on ridge" (*Hoogland 9792*); "slope about 70% covered tussock grassland, formerly forested, black amorphous, richly organic soil" (*Walker ANU5063*) and "common on forest-grassland edge" (*Hoogland & Pullen 5631*). Flowering occurs from (February-) April to August, fruiting from May to September.

Local name: Ninbug (Chimbu: Waimambano; *Hoogland & Pullen 5631*).

Specimens examined:

PAPUA NEW GUINEA: Anderson 21, 25.ix.1960, Mount Wilhelm, BRI (fl., fr.); *Balgooy 102,* 26.iv.1965, ridge N. of Lake Aunde, Mt. Wilhelm, PNH (fr.); *Balgooy 936,* 29.vi.1965, Bendenumban Valley, Mt. Wilhelm, CANB, PNH (fl.); *Brass 22252,* 19.v.1953, Maneau Peak, Mt. Dayman, A, CANB (fl.); *Brass 22447,* 24.v.1953, north slopes of Mt. Dayman, CANB (fl., fr.); *Brass 29802,* 11.vi.1959, east slopes Mt. Wilhelm, A, CANB, NY, PNH (fl.); *Brass 30112,* 23.vi.1959, east slopes Mt. Wilhelm, A, CANB (fl.); *Brass 30542,* 16.vii.1959, east

slopes Mt. Wilhelm, A, CANB, NY (fl., fr.); *Brass & Collins 31016*, 12.viii.1959, Mt. Otto, CANB, NY (fl., fr.); *Brass & Collins 31254*, 31.viii.1959, Mt. Michael, A, CANB, NY, PNH (fl., fr.); *Clemens 11345*, 6.ii.1940, Matap, A (fl.) — type of *H. sanguinea*; *Clemens 41378*, 18-20.v.1940, head Bonzok R., Rawlinson Range, A (fr.); *Clemens 41949*, 27.vi.1941, Rawlinson Range, A (fr.); *Clemens 102477*, 17.vi.1939, Mt. Sarawaket, A (fl.); *Craig 114*, 23.iv.1965, Capella vale, Telefomin subdist., CANB (fl., fr.); *Gillson NGF22372*, 22.viii.1965, Mt. Suckling, BISH, CANB (fl., fr.); *Henty & Carlquist NGF16581*, 10.ii.1963, Mount Piora, A, BRI, CANB (fr.); *Hoogland 9792*, 8.ix.1964, Korongowet, Salawaket Range, CANB (fr.); *Hoogland 9930*, 25.ix.1964, Gimdoh, Salawaket Range, A, BRI, CANB (fl.); *Hoogland 10010*, 6.x.1964, Mamsin, Salawaket Range, A, BRI, CANB (fl.); *Hoogland & Pullen 5631*, 18.vii.1956, near Lake Aunde, E. slope of Mt. Wilhelm, CANB, BISH, BRI, G, PNH, US (fl., fr.) — type of *H. microphylla*; *Millar NGF23206*, 3.ii.1964, Pengagl Creek, BRI, CANB (fl., fr.); *Millar & Sayers NGF23680*, 21.viii.1964, Pengagl Creek, BISH, BRI, CANB (fr.); *Philipson & Philipson 3436*, 22.viii.1968, west end of Lake Aunde, Mt. Wilhelm, CHR (fl., fr.); *Pullen 5035*, 6.vii.1963, Minj-Nona Divide, Kubor Range, S. of Minj, BRI, CANB (fl.); *Pullen 5133*, 26.vii.1963, Mt. Kinkain, Kubor Range, CANB (fr.); *Robbins 1172*, 20.viii.1957, Mt. Wilhelm, CANB (fl., fr.); *Sayers & Millar NGF19883*, 24.viii.1964, Lake Aunde, BRI, CANB (fl., fr.); *Vandenberg NGF35031*, 10.vi.1968, southern shore of Lake Aunde, CANB, PNH (fl., fr.); *Vandenberg NGF39571*, 17.vi.1968, Pindunde River, BRI (fl.); *van Royen NGF15166*, 22.ix.1962, Lake Aunde, BRI, CANB (fl.); *Vink 16102*, 16.vii.1963, summit of Mt. Kincain, Kubor Range, CANB (fl., fr.); *Walker ANU4*, -.vi.1961, Mt. Wilhelm, BRI (fl.); *Walker ANU5063*, 6.v.1965, south slope of Pindeaunde Valley, CANB (fl.); *Wardle s.n.*, 28.vi.1969, Imbuka Ridge, Mt. Wilhelm, CHR203507 (fl.); *Went 6*, 22-26.ix.1962, near Lake Aunde, GH (fl.); *Womersley NGF8922*, 31.vii.1956, vicinity of Lake Aunde, A, BRI, CANB (fl.).

The specimen *Brass 22447* differs from the normal form of the species in having markedly smaller flowers (ovary turbinate, 0.6 mm long, 0.8 mm wide, petals 1.2 mm long). However, another specimen from the same locality *(Brass 22252)* is normal in this respect, so more material would be desirable before any recognition of the former specimen as taxonomically distinct.

Another collection (*Craig 114*) has functionally female flowers with reduced petals and stamens, as occurs irregularly in other members of the genus. The same phenomenon is apparent to a lesser extent in the collection *Robbins 1172*, where some randomly distributed flowers in the inflorescence are functionally female, others have four sterile and four fertile anthers, and others are fully bisexual.

A small number of collections intermediate between this species and *G. halconensis* are known from the highlands of Papua New Guinea. See under *G. halconensis* for details.

8. **Gonocarpus halconensis** (Merr.) Orchard (Figs. 223-226)

Gonocarpus halconensis (Merr.) Orchard, comb. nov.

Haloragis halconensis Merrill, Philip. J. Sci. (Bot.) 2 (1907) 288 [Typus: "In open heaths at 2400 m. alt. (No. 5700)". Holotypus: n.v. Isotypi: *Elmer D. Merrill 5700*, Nov. 1906, Philippines, Mt. Halcon, Mindoro, NY, US710841 (fl.)!]; Gibbs, Phytog. & Fl. Arfak Mts. (1917) 159; van Steenis, Bull. Jard. Bot. Buitenz. III. 13 (1934) 218; Borgmann, Zeitschr. f. Bot. 52 (1964) 143, 160; Praglowski, Grana 10 (1970) 170; v.d. Meijden & Caspers, Fl. Males. 7 (1971) 245 p.p.

Haloragis suffruticosa Gibbs, Phytog. & Fl. Arfak Mts. (1917) 159 [Typus: "Arfak Mts., Angi lakes, open marsh by ♀ lake, 7000′, abundant. Fl. (♂ stage). Dec. 5555. — Fl. (♀ stage) 5942". n.v.]; Mansfeld, Bot. Jb. 61 (1927) 27; van Steenis, Bull. Jard. Bot. Buitenz. III. 13 (1934) 218; Merrill & Perry, J. Arn. Arb. 29 (1948) 162.

Haloragis suffruticosa var. *ramosa* Went, Nova Guinea 14 (1924) 108 [Typus: "Niederländisch Neu-Guinea: im Arfak-Gebirge bei den Angi-Seen 1900 m. u. M. '40 cm hoher Strauch auf moosbewachsener nasser Ebene mit gelben Bluten und blaulich-grunen Blattern' (Gjellerup n. 1161, — 29 April 1912)" Holotypus: n.v. Isotypus: *K. Gjellerup 1161*, 29.iv.1912, Nova Guinea neerlandica septemtrionalis, pr. lac. Angi in mont. Arfak. alt. 1900 m., U85737 (fl.)!]; Mansfeld, Bot. Jb. 61 (1927) 27.

Haloragis suffruticosa var. *galioides* Went, Nova Guinea 14 (1924) 109 [Typus: "Niederländisch Neu-Guinea: im Gautier-Gebirge 900 m. u. M. 'in offenem moosbewachsenem Walde, auf Kalkboden; Blüten rötlich braun, Antheren gelb' (Gjellerup n. 878, - 5 November 1911)". Holotypus: n.v.]; Mansfeld, Bot. Jb. 61 (1927) 27.

Haloragis fruticosa Went, Nova Guinea 14 (1924) 106, Tab. XIA. [Typus: "Niederländisch Neu-Guinea: Gipfel des Wichmann-Gebirges, 3000 m. u. M. 'Blüten rötlich braun, 2 m hoher Strauch' (Pulle n. 1008, - 3 Februar 1913); Rücken des Kajan - Gebirges 3200 m. u. M. 'Kletterpflanze (?) in offener Vegetation, Blüten rötlich braun' (Versteeg n., 2467 — 10 Februar 1913); Fuss des Doorman - Gipfels, 3280 m. u. M. '1 m hoher Strauch auf offenem Abhang zwischen Felsenblocken, Blütenteile rot his dunkelrot' (Lam n. 1604, - 17 October 1920)" Lectotypus (Orchard): *Pulle 1008* (as above) L. n.v., Tab. XIA l.c.! Isolectotypus: *A. Pulle 1008*, 3.ii.1913, Novam Guineam Meridionalem in mont. Wichmann, U8570 (fl., fr.)! Syntypi: *H. J. Lam 1604*, 17.x.1920, Nova Guineam neerlandica in reg. flum. Mamberamo, alt. 3280 m. in mont. Doorman, U85734 (fl., fr.); *G. Versteeg 2467*, 10.ii.1913, in Novam Guineam Meridionalem in summ. mont. Kajan, U85739 (fr.)!] Mansfeld, Bot. Jb. 61 (1927) 26; van Steenis, Bull. Bot. Jard. Buitenz. III. 13 (1934) 218; Merrill & Perry, J. Arn. Arb. 23 (1942) 408; Merrill & Perry, J. Arn. Arb. 29 (1948) 162; Hoogland, Blumea Suppl. 4 (1958) 229; Praglowski, Grana 10 (1970) 172.

Haloragis nemorosa Went, Nova Guinea 14 (1924) 107-108, Tab. XIB [Typus: "Niederländisch Neu-Guinea: im Arfak — Gebirge bei den Angi-Seen. 1900 m. u. M. '1.5 m hoher Strauch im Wald auf nassem Humus: Bluten

gelb, Blätter dunkelgrun' (Gjellerup n. 1050, - 26 April 1912)." Holotypus: n.v. (Went, l.c., Tab. XIB!) Isotypus: *K. Gjellerup 1050,* 26.iv.1912, Nova Guinea neerlandica septemtrionalis, pr. lac. Angi in mont. Arfak. alt. 1900 m., U85736 (fl.)!]; Mansfeld, Bot. Jb. 61 (1927) 26; van Steenis, Bull. Jard. Bot. Buitenz. III. 13 (1934) 218; Merrill & Perry, J. Arn. Arb. 23 (1942) 408; Praglowski, Grana 10 (1970) 172.

? *Haloragis secunda* Ridley, Trans. Linn. Soc. 9 (1916) 41 [Typus: "Camp VI b, 3900 ft." n.v.]; Went, Nova Guinea 14 (1924) 107-108; Mansfeld, Bot. Jb. 61 (1927) 26; van Steenis, Bull. Jard. Bot. Buitenz. III. 13 (1934) 218; Praglowski, Grana 10 (1970) 170.

? *Haloragis gjellerupi* Went, Nova Guinea 14 (1924) 107 [Typus: Niederländisch Neu-Guinea: im Arfak — Gebirge bei den Angi - Seen, 1900 m. u. M. 'nasser mooriger Seeufer auf Humus; Kelch rotlich braun gelb' (Gjellerup n. 1125, - 28 April 1912)" n.v.]; Mansfeld, Bot. Jb. 61 (1927) 26; van Steenis, Bull. Jard. Bot. Buitenz. III. 13 (1934) 218.

Figs.: Went, Nova Guinea 14 (1924) Tab. XIA-B; Praglowski, Grana 10 (1970) pl. 3 (h-i).

Perennial erect or semi-scandent herb or subshrub, 60 cm to 1 m tall, stems red-brown, ± 6-angled, at least the smaller ones clothed in semi-appressed or spreading, simple, 2-3-celled, transparent hairs 0.3-0.4 (-1.6) mm long.

Leaves relatively widely spaced (1-2 cm), in whorls of (2-) 3 (-5), on petioles 1.5-2.5 (-4.0) mm long, lanceolate to ovate, (1.0-) 1.5-2.0 (-4.0) cm long, (0.5-) 0.7-0.8 (-1.5) cm wide, thin, apex acute, base rounded, serrulate with (15-) 20-25 teeth, ± revolute in dried specimens, midrib sunken above, prominent below, lateral veins obscure, appressed pilose with hairs as for stems at least on lower surface and usually on upper surface, upper surface ± shiny, lower surface dull.

Inflorescence an indeterminate spike of individual flowers solitary in the axils of alternate primary bracts and subtended by two secondary bracts. Lateral inflorescences borne in the axils of the reduced upper whorled or alternate leaves. Primary bracts leaflike, green, fleshy, lanceolate,1.5-3.0 mm long, 0.5-0.8 mm wide, ± sessile, entire, midrib faint, ± pilose on lower surface. Secondary bracts brown, membranous, linear, often with two teeth near base, 0.6-0.7 mm long, 0.1 mm wide, ± glabrous (Fig. 224).

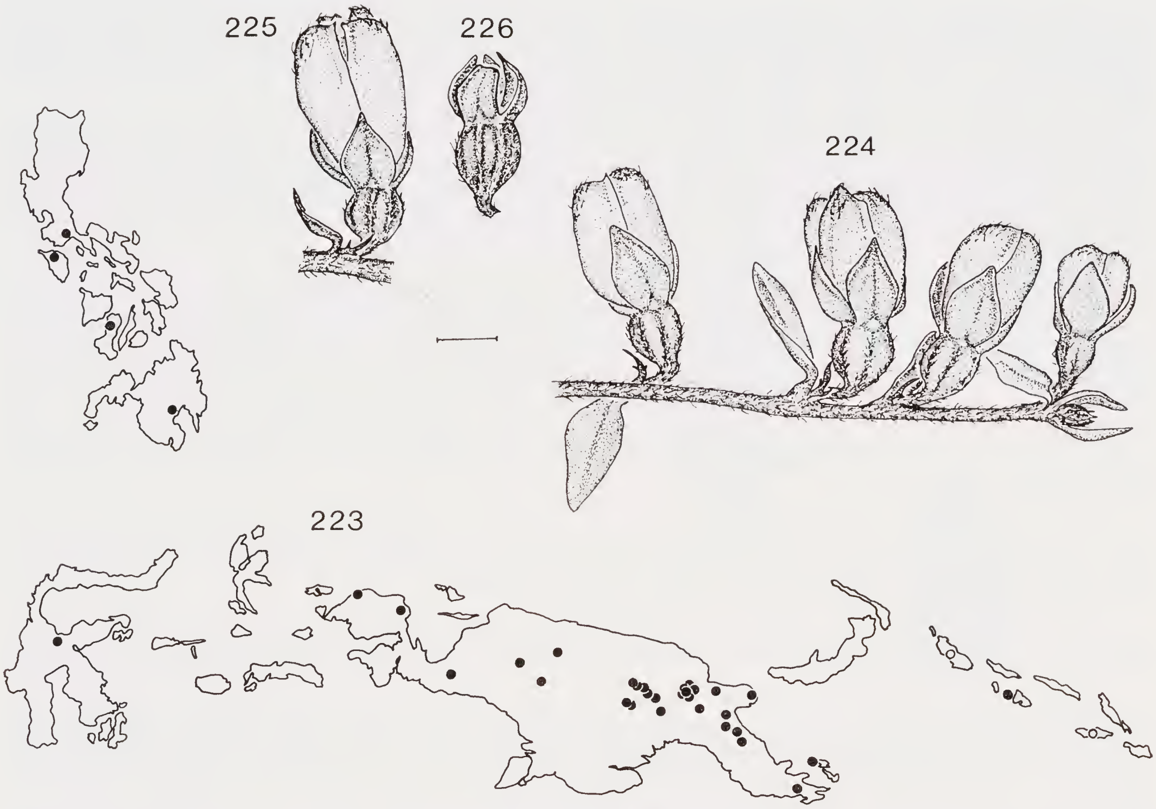
Flowers red, 4-merous (Fig. 225). Sepals 4, green, lanceolate, 1.2-1.5 mm long, 0.6-0.8 mm wide, faint median rib and basal median callus, margins thickened. Petals 4, red, hooded, tip hooked, non-unguiculate, 2.3-3.2 mm long, 0.4-0.7 mm wide (keel to margin), pilose on keel. Stamens 8, filaments 0.1-0.2 mm long; anthers yellow to red, oblong, 1.7-2.2 mm long, 0.2-0.3 mm wide, 4-celled, non-apiculate, anther of antisepalous stamens ca. 0.4 mm longer than that of antipetalous stamens. Styles 4, stigmas ± sessile, red, fimbriate, capitate. Ovary red-purple, ovoid, 0.8-1.3 mm long, 0.5-0.8 mm wide, ± 8-ribbed, pilose with very short, simple hairs at least on ribs; 1 locule (± 4 septa at extreme apex only), columella present, 4 pendulous ovules.

Fruit red-purplish, ovoid, 1.2-1.3 mm long, 1.0 mm wide, 8-ribbed, ± tuberculate on ribs because of hairs; sepals persistent, erect, green, lanceolate, 1.1 mm long, 0.7 mm wide, ± concave, margins thickened, midrib ± prominent, median basal callus; 1 seed, filling the entire fruit (Fig. 226).

Distribution: This species is known from the highlands of West Irian and Papua New Guinea, where it is fairly widespread, and from scattered localities in the Philippines, British Solomons and Celebes (Fig. 223).

Ecology: The shrubby or herbaceous form of *G. halconensis* is usually found in open situations at or near the tree (= shrub) line in subalpine vegetation, within the altitudinal limits 1600-2700 (-3500) m. A semi-scandent form is sometimes found in more overgrown situations in mossy or mixed *Nothofagus* forest. In this latter habitat the leaves are often wholly or partly in opposite pairs instead of the usual whorls of three (see below). This species grows side by side with *G. sanguineus* at their region of altitudinal overlap on Mt. Wilhelm (3500 m — *Brass 30134,* unspecified — *Balgooy 594*). There are also a number of intermediate specimens in this region, suggesting a certain amount of hybridisation. Collectors' notes on habitat include "forming shrubberies on edges of *Equisetum-Carex* bog in forest" (*Brass 30543*), "common on grassy banks of a stream" (*Brass 11672*), "mossy forest, massed in a small opening, scrambling" (*Brass 12673*), "open crest in *Nothofagus*-Ericaceae forest" (*van Royen NGF20298*), "vigorous vine in lower moss forest" (*Hartley & Sayers 12670*), "in tall grassland on peaty soil, usually on open patches" (*Hoogland & Pullen 6048*), and "edge of mixed *Nothofagus, Podocarpus, Pandanus* forest, herb semi-scandent to 4 ft. high" (*Pullen 137*). Flowering occurs more or less all year round but particularly from January to October, while fruiting occurs from February to November.

Local names: Tani (Southern Highlands, Papua New Guinea; *Frodin NGF28297*); Kapugunde (Enga language, Kepilam; *Hoogland & Schodde 7524*); Kempargarafe (Okapa, Western Highlands; *Wheeler ANU6170*).



Figs. 223-226. *Gonocarpus halconensis*. 223. Distribution. (● = specimens examined; ○ = other records from the literature). 224. Tip of inflorescence. 225. Flower. 226. Fruit. (figs. 224-226 from *Pullen 6099*). Scale represents 1 mm (figs. 224-226).

Specimens examined:

PHILIPPINES: Clemens s.n., -.vi.1924, Mt. Apo, NY, P (fl., fr.); *Edano 8179,* 10.iv.1954, summit Mt. Canlaon, PNH (fr.); *Holman 2,* 18.iii.1911, Mt. Banajao, Luzon, GH (fr.); *Hosokawa 8602,* 11.ix.1936, Mt. Aposan, BISH (fl., fr.); *Lobb 448,* Luzon, CGE (fl., fr.); *Loher 13680,* -.iii.1915, Mt. Banahao, M (st.); *Merrill 238,* -.iv.1910, Canlaon Volcano, M, U (fl., fr.); *Merrill 5700,* -.xi.1906, Mt. Halcon, NY, US (fl.) — type of *H. halconensis. CELEBES: Eyma 3607,* 9.iv.1938, top of Mt. Loemoet, Menado, Poso, A, U (fl., fr.). *WEST IRIAN: Brass 11672,* -.xii.1938, Balim River, A, BRI (fl.); *Brass 12673,* -.ii.1939, 18 km S.W. of Bernhard Camp, Idenberg River, A, BRI (st.); *Brass & Teerink 9262,* -.viii.1938, Lake Habbema, A (fl.); *Eyma 4275,* 9.i.1939, Wissel Lake Region, A (fl.); *Gjellerup 1050,* 26.iv.1912, pr. lac Angi in mont. Arfak, U (fl.) — isotype of *H. nemorosa*; *Gjellerup 1161,* 29.iv.1912, pr. lac. Angi in mont. Arfak, U (fl.) — isotype of *H. suffruticosa* var. *ramosa; Kanehira & Hatusima 13472,* 5.iv.1940, Angi, Arfak Mts., A (fr.); *Kanehira & Hatusima 14108,* 10.iv.1940, Lake Gita, Angi, Arfak Mts., A (fl.); *Lam 1604,* 17.x.1920, in reg. flum. Mamberamo, in mont. Doorman, U (fl., fr.) — syntype *H. fruticosa*; *Pulle 1008,* 3.ii.1913, in mont. Wichmann, U (fl., fr.) — isolectotype of *H. fruticosa*; *van Royen & Sleumer 7208,* 2.xi.1961, Aifat River valley, Tamran Mts. East, A, CANB (st.); *Versteegh BW285,* 22.ii.1954, Anggigita Lake, G. Mesenuk, A, CANB (fl., fr.). *PAPUA NEW GUINEA: Balgooy 594,* 7.vi.1965, Pindeaunde valley, Mt. Wilhelm, CANB, PNH (fl., fr.); *Brass 24524,* 9.x.1953, Goodenough Island, A, CANB (fl., fr.); *Brass 30134,* 24.vi.1959, east slopes, Mt. Wilhelm, A, CANB, NY, PNH (fl., fr.); *Brass 30266,* 2.vii.1959, east slopes, Mt. Wilhelm, A, CANB, NY, PNH (fl., fr.); *Brass 30543,* 16.vii.1959, east slopes, Mt. Wilhelm, A, CANB, NY (fl., fr.); *Brass 31438,* 6.ix.1959, Mt. Michael, A, CANB, NY (fl., fr.); *Clemens 7086,* 15.ix.1937, Sattelberg, Batop vicinity, A (fr.); *Coode & Katik NGF 32869,* 7.vi.1968, Kaindi, Wau subdist., CANB (fl., fr.); *Frodin NGF28297,* 10.viii.1966, S.E. slope of Mt. Ambua, BISH, BRI, M, PNH (fl., fr.); *Frodin NGF28365,* 16.viii.1966, Tari, BISH, BRI, M, PNH (fl., fr.); *Hartley 12570,* 17.xii.1963, Mt. Shungol, about 5 miles [8 km] S.W. of Wagau, A (fl., fr.); *Hartley 12798,* 24.i.1964, above Bakaia, about 15 miles [24 km] S.E. of Garaina, A, CANB (fl., fr.); *Hartley & Sayers 12570,* 17.xii.1963, Mt. Shungol, about 5 miles [8 km] S.W. of Wagau, BRI, CANB (fl., fr.); *Henty NGF29076,* 23.xi.1966, Lake Trist, BRI, CANB (fl., fr.); *Hoogland & Pullen 6048,* 28.viii.1956, near Tomba Village, south slope of Mount Hagen Range, A, CANB (fl.); *Hoogland & Schodde 7524,* 20.viii.1960, Yobobos grassland area, source of Lagaip River, CANB (fl.); *Pullen 137,* 12.vii.1957, east rim of Mt. Oga, ca 12 miles [19 km] east of Hagen Station, CANB (fl., fr.); *Pullen 2706,* 8.vii.1961, ca 1 mile [2 km] W.N.W. of Ialibu patrol post near the Iaro River, CANB (fr.); *Pullen 6099,* 15.xi.1964, near Lake Naho, S.S.W. of Mt. Abilala, Finisterre Range, CANB (fl.); *Robbins 256,* 7.vii.1957, road above Tomba, CANB (fl.); *Robbins 3372,* 26.viii.1960, Yaboi Valley, Upper Wage, S.W. of Laiagam, CANB (fl.); *Schodde 5432,* 15.vii.1969, Aparamu Ridge,

eastern Mt. Simpson Range, CANB (fl., fr.); *van Royen NGF18376,* 3.ix.1963, Mt. Ormogadzin, W. of Mt. O Dan, BRI, CANB (fr.); *van Royen NGF20298,* 11.i.1965, road from Woitape to Kosipi, E. slope of Wosa, BRI, CANB (fl.); *Vink 16969,* 22.vi.1966, Ibiwarra, BISH, CANB (fl.); *Walker ANU525,* 10.viii.1962, Sirunke, CANB (fl., fr.); *Wheeler ANU6170,* 15.vi.1966, Tomba track, S.W. side of Mt. Hagen, CANB (fl.). *BRITISH SOLOMON ISLANDS: Green 1967,* 1965, Kolombangara, A (fr.).

Some specimens of this species from the Philippines differ from those in New Guinea in having much larger leaves (4.0 x 1.5 cm vs. 1.5-2.0 x 0.7-0.8 cm) and longer, narrower sepals with $\pm$ suppression of the median basal callus. However, in view of the paucity of Philippines material, and the wide variation apparent in the New Guinean specimens, it seems unwise to attach much importance to these differences.

Some collections, particularly those from mossy forests where the plant often assumes a semi-scandent habit, have opposite leaves instead of the more usual whorls of three (e.g. *Brass 12673, Gjellerup 1050, Pullen 137* and *van Royen NGF18376*). That this is not particularly significant is shown by other specimens, where a variety of leaf arrangements occur on the one plant (e.g. *van Royen NGF20298* — whorls of 3 or opposite, *Versteegh BW285* — alternate, opposite, whorls of 3, 4 and 5). Went used the presence of opposite leaves as one of the features separating *H. gjellerupi, H. nemorosa* and *H. fruticosa* from other New Guinean species of this group, a distinction that no longer seems valid.

Lectotypification of the name *Haloragis fruticosa* Went is necessary as three specimens were cited with the original description. The one here designated (*Pulle 1008*) is illustrated by a photograph in the original publication and therefore seems the logical choice.

The specimen *Lam 1604* differs in having glabrous petals, although it is normal in other respects, while the collection *Henty NGF29076* has flowers and fruits much more densely pilose than is normal.

Although *G. halconensis* and *G. sanguineus* are more or less separated geographically and altitudinally, there is some overlap of range, particularly in the region of Mt. Wilhelm, in Papua New Guinea. As the two species are closely related, there is, not unexpectedly, some intergradation suggestive of hybridisation. Some marginally intergrade specimens fairly closely resembling *G. halconensis* have been referred to that species (e.g. *Brass 30134, 30543, 31438*). Others, distinctly intermediate, are listed below.

WEST IRIAN: Versteeg 2467, 10.ii.1913, in summ. mont. Kajan, U (fr.) — syntype of *H. fruticosa. PAPUA NEW GUINEA: Balgooy 102,* 26.iv.1965, ridge N. of Lake Aunde, CANB (st.); *Balgooy 421,* 22.v.1965, S. of Lake Aunde, CANB (fl.); *Balgooy 892,* 27.vi.1965, Pengagl Creek, Mt. Wilhelm, CANB (fl., fr.); *Brass & Collins 31015,* 12.viii.1959, Mt. Otto, A, CANB (fl., fr.); *Henty et al. NGF42748,* 28.x.1969, Hong Kong Hill, Ok Tedi headwaters, BRI, CANB (fl.).

One of the syntypes of *H. fruticosa* (*Versteeg 2467*) falls into this category of intergrade specimens, although the lectotype and the other syntype are referred to *G. halconensis.*

9. **Gonocarpus longifolius** (Schindl.) Orchard (Figs. 227-230)

Gonocarpus longifolius (Schindl.) Orchard, comb. nov.

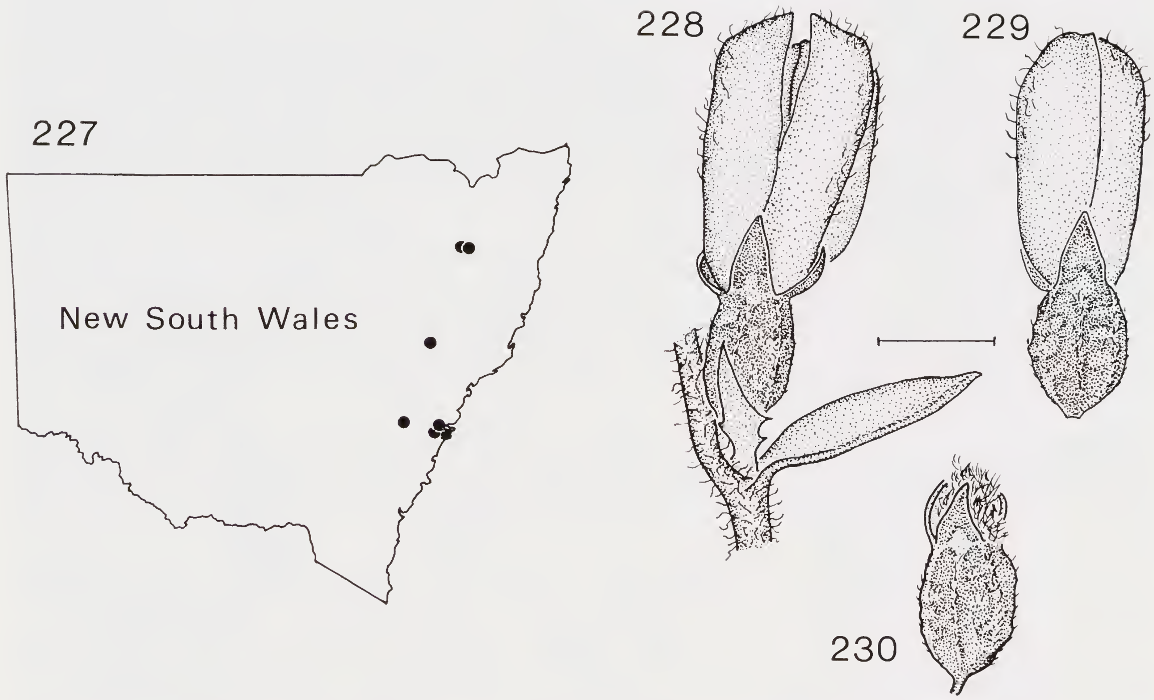
Haloragis longifolia Schindler, Pflrch 23 (1905) 35 [Typus: "Australien: Neu-Süd-Wales, auf steilen Hügeln von Leuwins Land (Bauer), Port Jackson (Anderson); ohne Standortsangabe (Caley — Herb. Delessert, Göttingen, Wien." Lectotypus (Orchard): *Anderson s.n.,* 1832, in Nova Hollandia orient. pr. Port Jackson, GOET (fl., fr.)! Isolectotypi: *Allan Cunningham, Anderson and others,* Australia, CGE! MEL39364 p.p.!, U118397B! (fl., fr.); *Anderson s.n.,* 1832, Port Jackson, G (herb. Deless.) (fl., fr.)! Syntypi: *Bauer s.n.,* Nov. Holland oris australis Leuwins Land in collibus asperis, W (st.)!; *Caley s.n.,* Nova Hollandia, G (herb. Deless.)!, NSW113171!, W (herb. Maille — 2 sheets)! (fl , fr.)] Schindler, Bot. Jb. 34 Beibl. 77 (1904) 42; Britten, J. Bot. 45 (1907) 136; Maid. & Betche, Census N.S. Wales Pl. (1916) 158; Praglowski, Grana 10 (1970) 170.

Haloragis villosa Schindler, Pflrch 23 (1905) 31 [Typus: "Australien: Neu-Süd-Wales, bei Jenolan (Blackey in Herb. bot. Gard. Sidney n. 18). — Herb. Berlin." Holotypus: probably destroyed. Isotypus: *W. F. Blakely s.n.,* -.i.1900, Jenolan Caves, NSW113169 ("18") (fr.)!] Maid. & Betche, Census N.S. Wales Pl. (1916) 158; Beadle et al., Fl. Syd. Reg. (1972) 207.

Fig.: Schindler, Pflrch 23 (1905) fig. 9F, G.

Erect subshrub 35-100 cm tall, stems freely branching, reddish, smooth or 4-ribbed, moderately densely pilose with soft spreading or semi-appressed, simple, uniseriate, hyaline, 2-3-celled hairs (0.3-) 0.5-0.7 mm long.

Leaves opposite or in whorls of 3, becoming alternate or subopposite in upper part, linear-oblong, (1.3-) 1.5-2.5 (-3.2) cm long, 0.3-0.6 cm wide, margins thickened, serrate with 20-30 obliquely cuspidate



Figs. 227-230. *Gonocarpus longifolius*. 227. Distribution. 228. Flower with primary and secondary bracts. 229. Flower. 230. Fruit. (figs. 228-230 from *Boorman s.n.*, NSW99123). Scale represents 1 mm (figs. 228-230).

teeth 0.5 mm long, upper surface dark olive green, lower surface light green, tapering abruptly to base and apex, midrib channelled above, prominent below, lateral veins indistinct, petiole 1.0-2.0 mm long, lamina glabrous or sparsely beset with minute (less than 0.2 mm long) appressed hairs on upper surface, pilose below, particularly on midrib, with semi-appressed hairs as for stems.

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Lateral inflorescences arise in axils of upper leaves. Primary bracts green, fleshy, lanceolate, 2.7-3.5 (-5.0) mm long, 0.7-0.9 (-1.5) mm wide, weakly midribbed, margin entire (rarely ± weakly toothed), ciliate on margins otherwise ± glabrous. Secondary bracts brown, membranous, narrow-lanceolate, 0.7-0.9 mm long, 0.3-0.4 mm wide, serrate towards base, glabrous (Fig. 228).

Flowers 4-merous, on pedicels 0.4-0.5 mm long (Fig. 229). Sepals 4, green, oblong, 0.4-0.5 mm long, 0.3-0.4 mm wide, margin thickened, small white median basal callus, glabrous or scabrous. Petals 4, greenish, hooded, keeled, shortly unguiculate, (1.6-) 1.7-2.2 mm long, 0.5-0.6 mm wide (keel to margin), glabrous or very sparsely scabrous on keel. Stamens 8, filaments 0.2 mm long; anthers linear-oblong, 2.0-2.1 mm long, 0.2-0.3 mm wide, 4-celled, nonapiculate, antipetalous stamens sometimes abortive, reduced. Styles 4, clavate, 0.2 mm long, stigmas capitate. Ovary silver-grey, ovoid, 1.0 mm long, 0.8 mm wide, prominently 8-ribbed, 2-3 transverse or oblique calluses between ribs, or calluses sometimes reduced to tubercles on ribs, glabrous or scabrous, septa incomplete, 4 locules, 1 ovule per locule.

Fruit silver-grey to reddish, on pedicel 0.5 mm long, ovoid, 1.0-1.2 mm long, 0.7-0.9 mm wide, 8-ribbed, 2-3 transverse or oblique calluses between ribs, or calluses sometimes reduced to tubercles on ribs, glabrous, sepals persistent, erect, ± enclosing styles, 0.5-0.6 mm long, 0.3-0.4 mm wide; pericarp membranous, 1 seed (Fig. 230).

Distribution: *G. longifolius* is confined to eastern New South Wales, from near Picton to Armidale (Fig. 227).

Ecology: This species is apparently found in shrub communities on sandstone soils from near sea level to about 600 m. Collectors' notes include "in collibus asperis" (*Bauer s.n.*, W); "plants of 2-3 ft. high growing amongst coarse boulders of sandstone on the summit of the ranges, in the district. Such plants as *Grevillea longistyla, Cassinia aculeata* etc. grow near it." (*Boorman NSW99124*); "occasional on top of cliffs near river; sandstone." (*Constable 6175*). Flowering and fruiting take place from October to January.

Specimens examined:

NEW SOUTH WALES: Anderson s.n., 1832, Australia (Port Jackson), CGE, G (herb. Deless.), GOET, MEL39364 p.p., U118397B (fl., fr.) — types of *H. longifolia*; *Bauer s.n.*, Nov. Holland oris australis Leuwins Land, W (st.) — type of *H. longifolia*; *Caley s.n.*, Nova Hollandia, G (herb. Deless.), NSW113171, W (herb. Maille) (fl., fr.) — types of *H. longifolia*; *Blakely s.n.*, -.i.1900, Jenolan Caves, NSW113169 (fr.) — type of *H. villosa*; *Boorman s.n.*, -.xii.1908, Gungal, NSW99124 (fl.); *Boorman s.n.*, -.xii.1910, Georges River, NSW99123 (fl., fr.); *Constable 6175*, 11.x.1965, Nepean River, Douglas Park, NSW (fl., fr.); *Cunningham s.n.*, 1837, Sydney Bot. Gard., MEL1003651 (fl.); *Staer s.n.*, -.xi.1910, Georges River, NSW99099 (fl., fr.); *Woolls s.n.*, Paramatta, MEL39433 (fr.).

Schindler described both *Haloragis longifolia* and *H. villosa* in the same publication (Schindler, 1905). However, the only qualitative difference between the taxa is that the ovary and fruit of "*H. villosa*" is ± scabrous, while that of "*H. longifolia*" is glabrous. As the type collection is the only one known of "*H. villosa*", it seems likely that this is only a chance variant, as is known to occur in other species, e.g. *G. elatus*. Schindler's two taxa are therefore considered conspecific, and united under the name *Gonocarpus longifolius*.

There is a considerable range of sex expression in this species. Flowers on the same plant (e.g., *Boorman NSW99123)* may have all stamens functional or the antipetalous ones abortive and much reduced. Complete reduction of all stamens and petals to form functionally female flowers is also known (e.g. *Anderson s.n.*, G, GOET, U).

Of the three collections cited by Schindler, the Anderson one is here chosen as lectotype because it constitutes the most complete collection of the three, and is represented in several herbaria.

This species comes closest to *G. humilis* in most respects, but differs in its habit (erect versus prostrate), proportionately narrower leaves and flowers with 8 stamens at least potentially fertile.

10. **Gonocarpus oreophilus** Orchard (Figs. 231-234)

Gonocarpus oreophilus Orchard, sp. nov.

Frutex ramosissimus 0.5-1.5 m altus, caules 4-costati pilis patentibus (raro ± reflexis) simplicibus 1-2-cellularibus 0.1 (-0.15) mm longis dense vestiti.

Folia decussata (alternata versus inflorescentiam) ovata ad oblonga 1.0-3.5 cm longa, 0.5-1.4 cm lata, rotundata ad apices abrupte contracta ad petiolos, serrata dentibus 15-30 rotundatis vel maxime oblique cuspidatis 0.3-1.0 mm longis, margine incrassata, petioli 0.3-0.5 cm longi, laminae minute scabrae in superficiebus ambabus.

Inflorescentia spica indeterminata florum singulariter in axillis bractearum primariarum alternarum portatorum. Inflorescentiae laterales e foliorum summorum axillis ortae. Bracteae primariae foliaceae lanceolatae 2.0-3.0 mm longae 1.0-1.5 mm latae integrae scabrae in superficiebus ambabus et marginibus pilis eodem modo ac in caulibus. Bracteae secundariae cinnamomeae membranaceae late lanceolatae ad ovatas 0.5-0.8 mm longae 0.3-0.4 mm latae, margines fimbriati, interdum fissae formantes 3 lobos angustos scabrae in superficiebus exterioribus pilis eodem modo ac in caulibus.

Sepala 4, viridia lanceolata ad ovata 0.6-0.7 mm longa 0.3-0.4 mm lata margines incrassatae, callo basali mediano infirmo, glabra. Petala 4 rubra ad lutea cucullata carinata breviter unguiculata (2.0-) 2.3-3.1 mm longa 0.6-0.7 mm lata (carina ad marginem) scabra in carina. Stamina 8, filamenta 0.1-0.2 mm longa; antherae luteae anguste oblongae (1.5-) 2.1-2.2 mm longae 0.4 mm latae 4-cellulares nonapiculatae. Styli 4, clavati 0.2-0.3 mm longi; stigmata capitata fimbriata. Ovarium ovoideum 1.1-1.4 mm longum 0.8-0.9 mm latum 8-costatum callis 0-2 ± obliquis infirmis inter costas, scabrum; incomplete 4-loculare, ovulum 1 per loculum.

Fructus argenteo-cinereus ad violaceum ovoideus (1.1-) 1.2-1.3 mm longus 0.8-0.9 mm latus valde 8-costatus ± laevis inter costas vel callis 2-3 ± obliquis infirmis, scaber; sepala persistentia erecta viridia ovata 0.6-0.7 mm longa 0.4-0.5 mm lata, callo basali infirmo mediano, margines incrassatae; semen unum.

Typus: *C.T. White s.n.*, -.xii.1915, Queensland, Macpherson Range, very common, forest country. Holotypus: BRI080133 (fl., fr.)! (Fig. 231). Isotypus (?); NSW99008 (fl.)!

Intricate shrub 0.5-1.5 m tall, stems green to red-brown, 4-ribbed, densely clothed with spreading (sometimes ± reflexed) simple 1-2-celled hairs 0.1 (-0.15) mm long.

Leaves decussate, becoming alternate in upper part, ovate to oblong, 1.0-3.5 cm long, 0.5-1.4 cm wide, rounded at apex, tapering abruptly to petiole, margin thickened, serrate with 15-30 rounded or extremely obliquely cuspidate teeth 0.3-1.0 mm long, petiole 0.3-0.5 cm long, lamina slightly darker green above than below, midrib sunken above, prominent below, lateral veins obscure, scabrid on both faces with minute hairs as for stems.

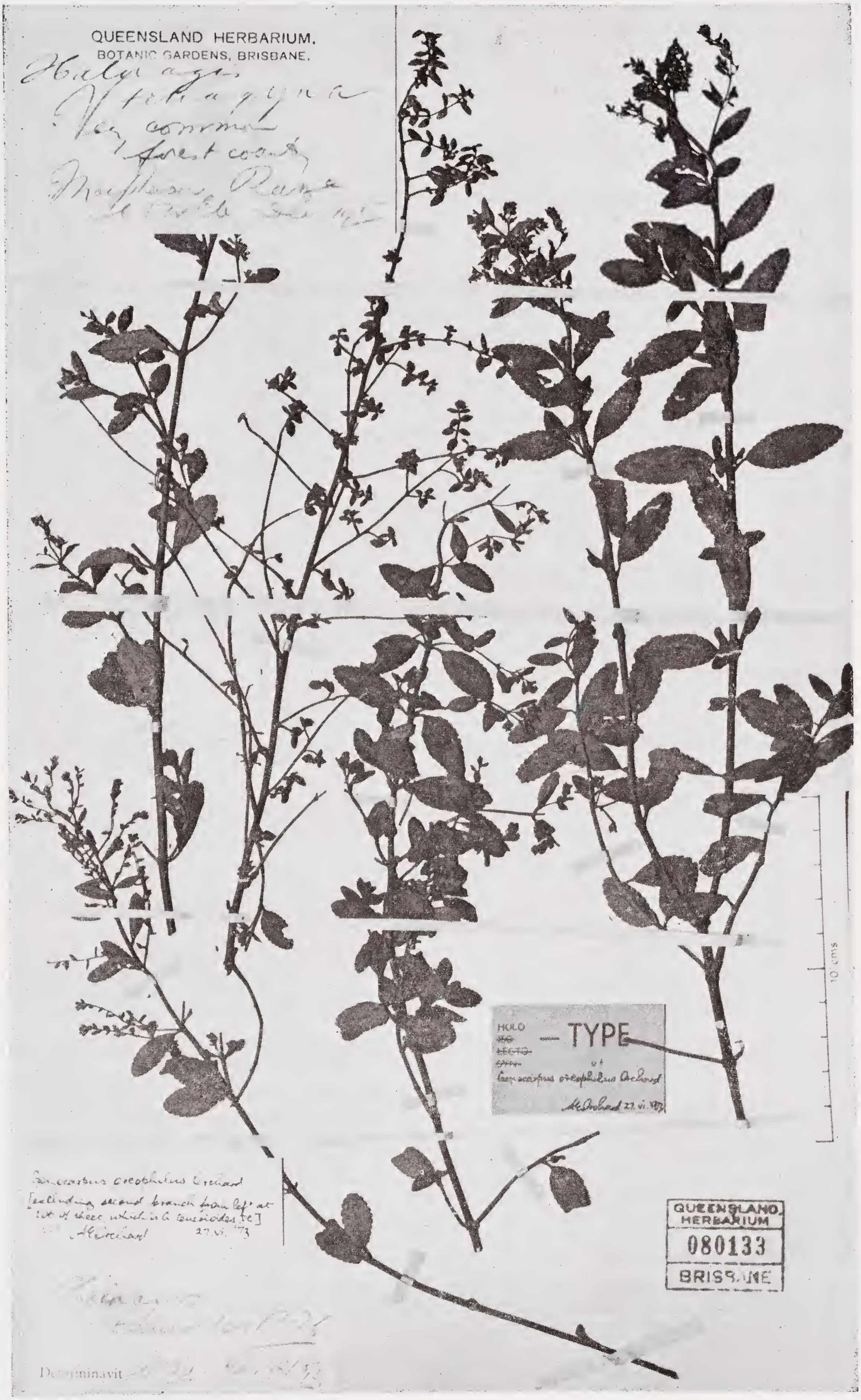


Fig. 231. Holotype of *Gonocarpus oreophilus*.

Figs. 232-234. *Gonocarpus oreophilus*. 232. Distribution. 233. Flower with primary and secondary bracts. 234. Fruit. (figs. 233, 234 from *Blake 15384*). Scales represent 1 mm (figs. 233, 234).

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Lateral inflorescences arise in axils of upper leaves. Primary bracts leaflike, green, fleshy, lanceolate, 2.0-3.0 mm long, 1.0-1.5 mm wide, entire, scabrous on both faces and margins with hairs as for stems. Secondary bracts yellow-brown, membranous, broad-lanceolate to ovate, 0.5-0.8 mm long, 0.3-0.4 mm wide, margin fimbriate, sometimes ± cut to form 3 narrow lobes, scabrous on outer face with hairs as for stems (Fig. 233).

Flowers 4-merous on pedicels 0.1-0.2 mm long. Sepals 4, green, lanceolate to ovate, 0.6-0.7 mm long, 0.3-0.4 mm wide, margins thickened, weak median basal callus, glabrous. Petals 4, red to yellow, hooded, keeled, shortly unguiculate, (2.0-) 2.3-3.1 mm long, 0.6-0.7 mm wide, scabrous on keel. Stamens 8, filaments 0.1-0.2 mm long, anthers yellow, linear-oblong, (1.5-) 2.1-2.2 mm long, 0.4 mm wide, 4-celled, nonapiculate, equal. Styles 4, clavate, 0.2-0.3 mm long, stigmas red-orange, capitate, fimbriate. Ovary ovoid, 1.1-1.4 mm long, 0.8-0.9 mm wide, 8-ribbed with 0-2 weak ± oblique calluses between ribs; incompletely 4-locular, with 1 ovule per locule.

Fruit subsessile, silver-grey to reddish-purple, ovoid, (1.1-) 1.2-1.3 mm long, 0.8-0.9 mm wide, strongly 8-ribbed, ± smooth between ribs or with 2-3 weak ± oblique calluses, scabrous; sepals persistent, erect, green, ovate, 0.6-0.7 mm long, 0.4-0.5 mm wide, thickened margin, weak median basal callus; septa incomplete, 1 seed (Fig. 234).

Distribution: *G. oreophilus* extends from the vicinity of Sydney to south-eastern Queensland, at altitudes between 300 and 1500 m, on the eastern side of the Great Dividing Range (Fig. 232).

Ecology: This species has usually been found in open or disturbed positions in the understory of rainforest communities, or in adjacent wet sclerophyll forest. Collectors' notes include "common in ± open places, on damp open forest hillside" (*Blake 15384*); "wet sclerophyll forest slopes" (*Coveny NSW 132760*); "intricately branched subshrub on trachytic tuff" (*Everist 1178*); "frequent locally in *Eucalyptus* forest adjacent to rainforest" (*Johnson NSW99007*) "rainforest undershrub" (*Jones 2999*); "spreading semiprostrate shrub in rainforest" (*Orchard 2382*). Flowering takes place from November to February, and fruiting from December to May.

Specimens examined:

QUEENSLAND: Blake 15384, 20.xii.1943, Macpherson Range, on and near Mt. Roberts, BRI (fl., fr.); *Everist 1077,* 19.iv.1935, Egg Rock, Numinbah Valley, BRI (fr.); *Everist 1167, 1178,* 16.vi.1935, Flinders Peak, BRI (fr.); *Goy & Smith 188,* 30.i.1938, Springbrook, BRI (fr.); *Johnson s.n.,* 19.v.1951, Mt. Roberts, Macpherson

Range, NSW99007 (fr.); *Maiden s.n.*, -.xi.1897, Seaview Range, Mt. Maiden, NSW99010 (fl.); *White s.n.*, -.ii.1912, Macpherson Range, BRI080131 (fl.); *White s.n.*, -.xii.1915, Macpherson Range, BRI080133 (fl., fr.) — holotype of *G. oreophilus*; *White s.n.*, -.xii.1915, Macpherson Range (Springbrook), NSW99008 (fl.) — ? isotype of *G. oreophilus*. *NEW SOUTH WALES: Anon s.n.*, Stony Creek, Camden, MEL39475 (fr.); *Anon.* [? *Leichhardt*] *224*, -.i.-, Goffs Gully, MEL39479, 1003729 (fr.); *Beckler s.n.*, Macleay River, MEL39482 (fl., fr.); *Burgess s.n.*, 27.iii.1962, Manning River National Forest No. 1, CBG010917 (st.); *Burgess s.n.*, 28.iii.1962, Manning River National Forest No. 1, CBG019120 (st.); *Burgess s.n.*, 9.xi.1966, 22 miles [35 km] from Belangry via Wauchope, AD96911101, CBG018403 (st.); *Burgess 172*, 17.ix.1962, Big Nellie Area, Manning River National Forest, NSW99005 (st.); *Crawford s.n.*, 28.xii.1963, Gwydir Highway, 36 miles [58 km] east of Glen Innes, CBG019119 (fl.); *Coveny s.n.*, 4.ix.1967, Mograni Mt., 2 miles [3 km] E of Gloucester, NSW132759 (st. — seedlings); *Coveny s.n.*, 9.ix.1967, between Mt. Gibraltar & Killabakh Ck., N. of Wingham, NSW132760 (st.); *Forsyth s.n.*, -.xi.1898, Mt. Warning, AK72972, NSW99009 (fl.); *Fraser & Vickery 58*, 9.i.1934, Barrington Tops, NSW (st.); *Guilfoyh s.n.*, 1871, Mt. Warning, MEL1003751 (fl.); *Jones 2999*, 28.v.1965, Whian Whian, CANB (st.) — voucher for Aust. Phytochem. Survey, sample no. 7724, sub nom. *Haloragis teucrioides*; *Maiden s.n.*, -.xii.1907, Wilsons Peak, NSW99011 (fl.); *Orchard 2382*, 27.x.1969, Whian Whian State Forest, AD (st.); *Salasoo 2854*, 4.i.1964, Ellenborough Falls, NW of Wingham, NSW (fl., fr.); *Webb & Tracey s.n.*, 1953-1958, Whian Whian State Forest, BRI037268 (st.).

Specimens representing this species have in the past been referred to *Gonocarpus* ('*Haloragis*') *tetragynus*, or, more often, *G.* ('*Haloragis*') *teucrioides*. With the former species it has little in common, but *G. teucrioides* and *G. oreophilus* probably have some affinity. *G. oreophilus* is however easily distinguished from *G. teucrioides* by its more oblong leaves, consistently alternate flowers, and much finer indumentum. *G. oreophilus* shares its woody habit only with *G. teucrioides*, *G. sanguineus*, *G. halconensis* and *G. longifolius*, and these five species form a distinct subgroup within the genus. Of the other four, *G. longifolius* is probably most closely related to *G. oreophilus*.

Guilfoyh MEL1003751 recorded the following account of the plant: "This plant was found in great quantity on the top of Mt. Warning. It was so plentiful that we gathered sufficient to make our beds in a very few minutes, but we had not long stretched ourselves upon it, when, strange to say, we (three in number) were seized with a fit of vomiting which lasted for some time. We did not know what to attribute this to, unless the weed in question. There was an odour to it when bruised between the fingers, but not unpleasant. I have never noticed the plant elsewhere and merely mention the above fact. Perhaps it possesses emetic properties so powerful that the smell might have been all sufficient."

The collections from Camden (*Anon. MEL39475*) and Goff's Gully (*Anon. 224*) differ from all the others in having rather long, soft hairs on the stems and leaves instead of the more normal short stiff ones. This is possibly the result of hybridisation with *G. longifolius* or *G. teucrioides*.

The type specimens of *Haloragis tetragyna* var. *hispida* Benth. (*Beckler s.n.*, Mount Mitchell, MEL 39483-7 (fr.); *Beckler s.n.*, Clarence River, MEL39488 (fr.) & lectotypus (Orchard) — MEL39483) are probably hybrids between this species and *G. elatus*.

11. **Gonocarpus humilis** Orchard (Figs. 235-238)

Gonocarpus humilis Orchard, sp. nov.

Herba perennis prostrata vel semiprostrata, caules 30-70 cm longi, infirme 4-costati, pilosi pilis albis mollibus patentibus uniseriatis 2-3-cellularis 0.3-0.5 mm longis.

Folia decussata, in petiolis 1-2 mm longis, distantia, ovata 1.1-1.8 cm longa, 0.6-1.2 cm lata, rotundata ad basim, acuta ad obtusa ad apicem, serrata dentibus 10-15 oblique cuspidatis 1.0-1.5 mm longis, pagina superior moderate dense pilosa adpressa, pagina inferior sparsim pilosa patens, praecipue in costa.

Inflorescentia spica laxa indeterminata florum portatorum singulatim in axillas bractearum primariarum alternarum. Inflorescentiae laterales in axillas foliorum superiorum 2-6. Bracteae primariae foliaceae lanceolatae 2.5-4.0 mm longae, 1.0-2.0 mm latae, integrae sparsim pilosae patentes. Bracteae secundariae membranaceae lanceolatae 0.8-1.0 mm longae, 0.3-0.4 mm latae, pilosae patentes.

Sepala 4, viridia deltoidea 0.6 mm longa, 0.6 mm lata, margines incrassatae, callo parvo medio basali, glabra. Petala 4, luteo-viridis cucullata carinata minute unguiculata, 0.8-1.5 mm longa, 0.5 mm lata, scabra in carina. Stamina 4, antisepala; filamenta 0.2 mm longa; antherae luteae inclusae petalis, oblongae (0.5-) 1.0-1.1 mm longae, (0.2-) 0.3-0.4 mm latae, 4-cellularis, nonapiculatae, raro staminodiis 4 antipetalis. Styli 4, lutei, clavati; stigmata capitata. Ovarium ovoideum 1.0-1.4 mm longum, 0.7-0.9 mm latum, 8-costatum, callis 2-3 obliquis inter costas, minute scabrum; incomplete 4-loculare, ovulum 1 per loculum.

Fructus argenteus ad purpurascentem, insidens pedicello 0.2-0.3 mm longo, ovoideus (1.1-) 1.3-1.5 mm longus, 0.9-1.1 mm latus, 8-costatus, callis 3 obliquis inter costas, minute scabrum; sepala persistentia, viridia deltata 0.5 mm longa, 0.5 mm lata, margines incrassati, callo medio basali, semen unum.

Typus: *A. E. Orchard 1919*, 9.ii.1969, Victoria, Grampians, Victoria Valley Road, ca ½ km west of junction with Halls Gap-Mt. Victory Road (ca 4 km west-south-west of Halls Gap). (fl., fr.). Holotypus: AD97222092[1] (Fig. 235). Isotypi: to be distributed.

Fig. 235. Holotype of *Gonocarpus humilis*.

Prostrate or semi-prostrate perennial herb, stems 30-70 cm long, green to reddish, weakly 4-ribbed, pilose with white, soft, spreading uniseriate 2-3-celled hairs 0.3-0.5 mm long.

Leaves decussate, on petioles 1-2 mm long, widely spaced, ovate, 1.1-1.8 cm long, 0.6-1.2 cm wide, rounded at base, acute to obtuse at apex, serrate with 10-15 obliquely cuspidate teeth 1.0-1.5 mm long, midrib sunken above, prominent below, secondary veins obscure, lamina dark green above, lighter below, upper surface moderately densely appressed pilose, lower surface sparsely spreading pilose, mainly on midrib, with hairs as for stems.

Inflorescence a lax indeterminate spike of flowers borne singly in the axils of alternate primary bracts. Lateral inflorescences arise in axils of upper 2-6 leaves. Primary bracts green, fleshy, leaflike, lanceolate, 2.5-4.0 mm long, 1.0-2.0 mm wide, entire, sparsely spreading pilose. Secondary bracts green to brown, membranous, lanceolate, 0.8-1.0 mm long, 0.3-0.4 mm wide (½ as long as ovary), spreading pilose.

Flowers 4-merous, on pedicels 0.1-0.2 mm long (Fig. 237). Sepals 4, green, deltoid, 0.6 mm long, 0.6 mm wide, margin thickened, small median basal callus, glabrous. Petals 4, yellow-green, hooded, keeled, very shortly unguiculate, 0.8-1.5 mm long, 0.5 mm wide, scabrous on keel. Stamens 4, antisepalous, filaments 0.2 mm long; anthers enclosed in petals, yellow, oblong, (0.5-) 1.0-1.1 mm long, (0.2-) 0.3-0.4 mm wide, 4-celled, nonapiculate; rarely 4 staminodes inserted opposite petals. Styles 4, yellow, clavate; stigmas capitate. Ovary ovoid, 1.0-1.4 mm long, 0.7-0.9 mm wide, 8-ribbed, 2-3 oblique calluses between ribs, minutely scabrous; incompletely 4-locular, 1 ovule per locule.

Fruit silver-grey to purplish, on pedicel 0.2-0.3 mm long, ovoid, (1.1-) 1.3-1.5 mm long, (0.9-) 1.0-1.1 mm wide, 8-ribbed with 3 oblique calluses between ribs, finely scabrous; sepals persistent, green, erect, deltoid, 0.5 mm long, 0.5 mm wide, margins thickened, median basal callus; 1 seed (Fig. 238).

Figs. 236-238. *Gonocarpus humilis*. 236. Distribution. 237. Flower (from *Reader s.n.*, MEL39520). 238. Fruit, with primary and secondary bracts (from *Orchard 1919*). Scales represent 1 mm (figs. 237, 238).

Distribution: *Gonocarpus humilis* is widespread in south-eastern Australia, extending from the Mount Burr-Mount Gambier region of South Australia, through southern Victoria, eastern Tasmania and New South Wales to the Moreton district in Queensland with isolated records from near Herberton and the Dalrymple Heights (Fig. 236).

Ecology: Little has been recorded of the habitat of this species, but it appears to favour damp or swampy areas at altitudes ranging from near sea level to about 1200 m. Collectors' notes include "occasional on edge of *Eucalyptus* forest; basalt" (*Constable 6312*); "dense mat in damp place amongst boulders on crest of ridge" (*Muir 3005*); "roadside swamp" *(Orchard 2025, 2026*); "in forest, on sandstone" (*Phillips CBG015600*). Flowering and fruiting occur from September until February.

Specimens examined:

QUEENSLAND: Clemens s.n., -.vii-xi.1947, Dalrymple Heights and vicinity, BRI080122 (fl., fr.); *Eichler 20717,* 6.vii.1970, Forest Reserve 194 in the Herberton Range west of Atherton, AD (fr.); *Hyland 3523,* -.vii.1964, Forest Reserve 194, Herberton, BRI075076 (fl., fr.); *White s.n.,* -.xii.1917, Upper Tallebudgera, Moreton Distr., BRI080123 (fr.). *NEW SOUTH WALES: Betche s.n.,* -.ii.1893, Brown Mountains near Littleton, NSW99025 (fr.); *Boorman s.n.,* -.xii.1909, Dorrigo, NSW99017 (fr.); *Camfield s.n.,* 1899, Kogarah, P (fl., fr.); *Constable 6312,* 16.xi.1965, Doyles River State Forest, 30 miles [48 km] northwest of Taree, BISH (fl., fr.); *Groome s.n.,* Harefield, MEL39506 (fr.); *Hamilton s.n.,* -.xii.1898, Mt. Wilson, NSW99339 (fl., fr.); *Hayes 17,* 24.ix.1958, Daisy Plains, Carrai Plateau, NSW99013 (st.); *Mueller s.n.,* Twofold Bay, MEL39452 (st.); *Phillips s.n.,* 10.vii.1961, Carrington Falls, CBG015600 (st.); *Rodway s.n.,* -.xi.1917, near Pigeon House Mt., Milton, NSW 98884 (fr.); *Woolls s.n.,* Bents Basin, MEL39489 (fr.). *SOUTH AUSTRALIA: Beek s.n.,* 11.xi.1970, Glencoe, AD97047112 (fl., fr.); *Hunt 1534,* 23.iii.1963, Mount Burr Pine Forest, AD (st.); *Ising s.n.,* 20.x.1934, The Springs, ca 16 km W. of Mt. Gambier, AD96830386 (fl.); *Orchard 2025, 2026,* 14.ii.1969, ca 5 km south-east of Glencoe, AD (fl., fr.). *VICTORIA: Davis s.n.,* 1890, Wimmera, MEL39149 (fl., fr.); *Eckert s.n.,* 1891, Lower Glenelg River, MEL39522, 1003755 (fl., fr.); *Lucas s.n.,* -.i.1886, Mts. Useful & Baw Baw, NSW99019 (fl., fr.); *Maiden s.n.,* -.i.1900, Mt. St. Bernhard, AK72967, NSW99026 (fr.); *Meebold 2510,* -.i.1929, Donna Buang, AD, M (fr.); *Morrison s.n.,* 14.xi.1885, Frankston, CANB127115 (fl.); *Muir 3005,* 1.i.1964, south-east of Tali Karng, near The Sentinels, MEL (fl., fr.); *Orchard 1880,* 7.ii.1969, Branch Creek, ca 5½ km south of the Victoria Valley Road junction with Bullawin Road, Grampians, AD (fr.); *Orchard 1919,* 9.ii.1969, Victoria Valley Road, ca ½ km west of junction with Halls Gap-Mt. Victory Road, AD (fl., fr.) — holotype of *G. humilis*; *Orchard 2008,* 13.ii.1969, "The Jackass" on Fitzroy River, AD (fl., fr.); *Phillips s.n.,* 22.xi.1961, Track to Sealers Cove, Wilsons Promontory, CBG015442, 015443 (fl.); *Reader s.n.,* 9.xi.1886, You Yangs, MEL39520 (fl., fr.); *Reader s.n.,* 3.xii.1905, County of Follett, MEL39518 (fl., fr.); *Tadgell 15,* -.xii.1914, Dargo Track, Mt. St. Bernard, MEL (fr.); *Walter s.n.,* -.x.1892, Grampians, MEL39521 (fr.); *Walter s.n.,* -.xi.1899, Grampians, MEL39447 (fr.); *Walter s.n.,* -.ix.1903, Upper Yarra, MEL39517 (fl., fr.); *White s.n.,* 18.i.1921, Powelltown, BRI080119, 080120 (fr.); *Wilhelmi s.n.,* Mount Abrupt, MEL39509 (fr.); *Willis s.n.,* 6.ii.1943, Echo Flat, Lake Mountain, E. of Marysville, MEL39390 (fr.). *TASMANIA: Anon. 87,* 14.xii.1887, Cataract-Launceston, MEL (fr.); *Blyth s.n.,* 1874, Honeywood, MEL39507 (fl., fr.); *Meebold 2074,* -.xii.1928, Sassafras, M (fl., fr.); *Phillips s.n.,* 11.xi.1965, 8 miles [13 km] from Forth, up Forth River, above Wilmot River, CBG 034563 (fl., fr.); *Rodway s.n.,* -.i.1901, Mt. Wellington, NSW99070 (p.p.).

In the past collections of this species have usually been determined as "forms" of *Gonocarpus* ('*Haloragis*') *tetragynus* or *G. teucrioides*, but *G. humilis* is distinguished from both of these species by its procumbent habit, lax inflorescence and tetrandrous flowers. It further differs from *G. tetragynus* in its spreading (rather than appressed) indumentum, and from *G. teucrioides* in its shorter bracteoles.

12. **Gonocarpus tetragynus** Labill. (Figs. 239-244)

Gonocarpus tetragynus Labill., Nov. Holl. Pl. Spec. (1805) 39, tab. 53 ('*tetragyna*') [Typus: "Habitat in capite Van-Dieman". Lectotypus (Schindler): *Labillardiere s.n.,* Nouv. Holl., G (herb. Deless.) (fr.)!], Drake (?), in Rees, Cyclop. 16 (1811).

Haloragis gonocarpus Sprengel, Syst. Veg. 2 (1825) 261 [nom. illeg. — based on *G. tetragynus*].

Gonocarpus tenellus DC., Prod. 3 (1828) 66 [Typus: "in Nova-Hollandia, comm. a cl. Lambert". Holotypus: *Lambert s.n.,* 1816, Nouv. Holland., G-DC (Photo!) — 2 sheets].

Haloragis tetragyna (Labill.) Hook. f., Fl. Nov. Zel. 1 (1852) 62; Gray, Bot. U.S. Expl. Exped. 1 (1854) 625; Hook. f., Fl. Tas. 1 (1856) 120, 2 (1859) 162; F. v. M., Fragm. 4 (1863) 26; Benth., Fl. Aust. 2 (1864) 484; Clarke, Fl. Br. Ind. 2 (1878) 430-431 p.p.; Tepper, Trans. R. Soc. S. Aust. 3 (1880) 38; Tate, Trans. R. Soc. S. Aust. 3 (1880) 64, 4 (1882) 106, 6 (1883) 156, 11 (1889) 83, 12 (1889) 95; F. v. M., Census 1 (1882) 50; Bailey, Syn. Qld Fl. (1883) 157; F. v. M., Key Syst. Vict. Pl. 2 (1885) 22, 1 (1887-8) 262; F. v. M., Trans. R. Soc. Vict. 24 (1888) 134; F. v. M., Sec. Census 1 (1889) 86; Featon, Art Alb. N.Z. Fl. (1889) 148 p.p.; Tate, Fl. S. Aust. (1890) 101; Moore, Hdbk. Fl. N.S. Wales (1893) 186; Bailey, Qld Fl. 2 (1900) 556 (excl. vars.); Rodway, Tas. Fl. (1903) 49; Schindler, Pflrch 23 (1905) 31; Dixon, Pl. N.S. Wales (1906) 130; Britten, J. Bot. 45 (1907) 135-136; Cheeseman, Trans. N.Z. Inst. 42 (1909) 202; Ridley, Trans. Linn. Soc. 9 (1916) 41; Maiden & Betche, Census N.S. Wales Pl. (1916) 158; Went, Nova Guinea 14 (1924) 107; Black, Fl. S. Aust. 3 (1926) 430; Ewart, Fl. Vict. (1930) 882; Webb, C.S.I.R.O. Bull. 241 (1949) 24; Black, Fl. S. Aust. 2 ed. 3 (1952) 643; Curtis,

Stud. Fl. Tas. 1 (1956) 188; Blake, Proc. R. Soc. Qld 73 (1963) 65; Evans, in Beadle et al., Hdbk. Vasc. Pl. Syd. Dist. (1963) 175; Praglowski, Grana 10 (1970) 168; Burbidge & Gray, Fl. A.C.T. (1970) 279; Willis, Hdbk. Pl. Vict. 2 (1972) 468; Beadle et al., Fl. Syd. Reg. (1972) 207.

Haloragis tetragyna var. *genuina* Schindler, Pflrch 23 (1905) 32 — *nom. inval.;* Britten, J. Bot. 45 (1907) 135-136.

Haloragis tetragyna var. *decumbens* Schindler, Pflrch 23 (1905) 32 [Typus: "Australien: Tasmania (F. Bauer, Gunn comm. Lindley); Ash-Insula (Schwartz in Exped. Novara). — Herb. Wien." Lectotypus (Orchard): *Schwartz s.n.*, Ash Island (Exped. Novara), W (fl., fr.)! Syntypi: *F. Bauer s.n.*, in Capite van Dieman, W (fr.)!; *Lindley s.n.*, 1839, V.D.L., W (fr.)! Isosyntypi (?): *R. C. Gunn s.n.*, 1863, Tasmania, G (herb. Boiss., DC.) (st.)!; *Lindley s.n.*, 1839, Terre de Van Dieman, G (herb. Boiss.) (fl., fr.)!]

Haloragis tetragyna var. *hispida* Schindler, Pflrch 23 (1905) 33, non Benth. (1864) [Typus: "Australien: ohne Standortsangabe (unbek. Sammler n. 539). — Herb. Wien ex Herb. Paris." Holotypus: n.v.] Britten, J. Bot. 45 (1907) 135-136; Maiden & Betche, Census N.S. Wales Pl. (1916) 158.

Haloragis tetragyna var. *lanceolata* Schindler, Pflrch 23 (1905) 33 [Typus: "Tasmania (Gunn, Hügel). — Herb. Wien". Holotypus: n.v.]

Haloragis tetragyna var. *serrata* Schindler, Pflrch 23 (1905) 33 [Typus: "Australien, Victoria (Wawra it. Cob. n. 542). — Herb. Wien." Holotypus: n.v. Isotypus: *Dr H. Wawra 542*, 1872/3, Victoria, Dandenong, NSW 113172 ex W (st.)!] Ewart, Fl. Vict. (1930) 882; Willis, Hdbk. Pl. Vict. 2 (1972) 469.

Haloragis tetragyna var. *bicallosa* Schindler, Pflrch 23 (1905) 33 [Typus: "Australien: Victoria (C. Walter, Wawra it. Cob. n. 596) — Herb. Wien." Holotypus: n.v.] Britten, J. Bot. 45 (1907) 135-136; Ewart, Fl. Vict. (1930) 882; Willis, Hdbk. Pl. Vict. 2 (1972) 469.

Haloragis rubra Schindler, Pflrch 23 (1905) 30-31 [Typus: "Australien: Victoria (C. Walter, comm. F. v. Müller). — Herb. Berlin, Bremen." Holotypus: n.v. Isotypi: *C. Walter s.n.*, Wimmera, Victoria, MEL39251 ex B!, NSW 87861 ex B! (fl.)] Schindler, Bot. Jb. 34 Beibl. 77 (1904) 30; Britten, J. Bot. 45 (1907) 135; Ewart, Fl. Vict. (1930) 880.

FIGS.: Labill., Nov. Holl. Pl. Spec. (1805) tab. 53; Schindler, Pflrch 23 (1905) fig. 8, 9C; Black, Fl. S. Aust. 3 (1926) fig. 175 A-C; Black, Fl. S. Aust. ed. 2. 3 (1952) fig. 868A-C; Praglowski, Grana 10 (1970) 189, pl. 3 (a-d).

Erect or ascending perennial herb 15-30 cm tall, older plants spreading via horizontal stolons, stems reddish-purple to green, very weakly 4-ribbed or ± lacking ribs, often rooting at lower nodes, appressed pubescent with simple white unicellular hairs 0.2-0.3 mm long.

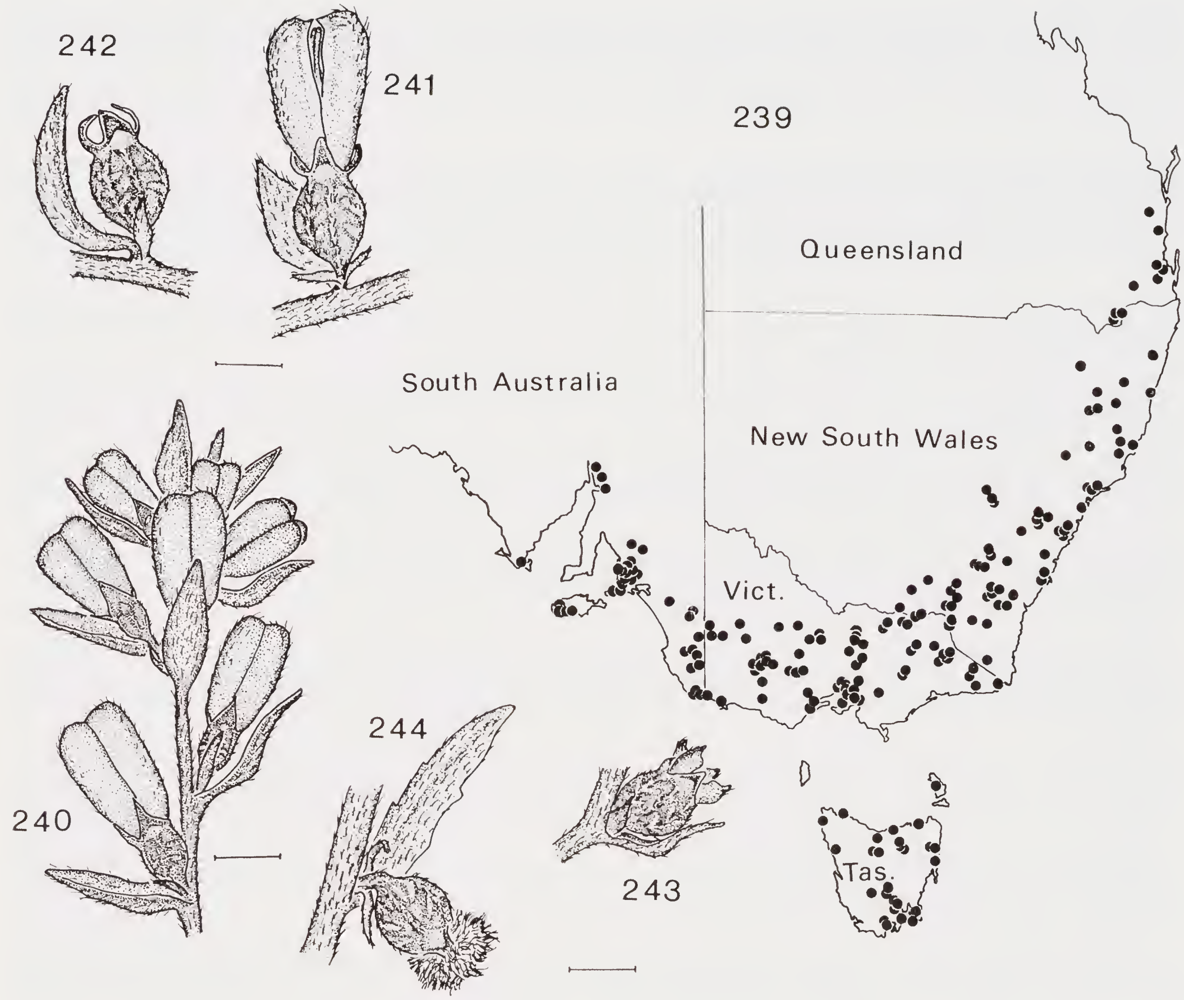
Leaves decussate, ± sessile on petioles 0.5-1.0 mm long, lanceolate, (0.4-) 0.6-1.2 (-2.0) cm long, 0.15-0.45 (-1.0) cm wide, margins thickened, serrate with 4-8 (-14) obliquely cuspidate teeth 0.5 mm long, midrib obscure or slightly channelled above, prominent below, lateral veins obscure, densely appressed pubescent on both faces with hairs as for stems.

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Lateral inflorescences arise in axils of upper leaves. Primary bracts leaflike, sessile, lanceolate, 2.0-2.5 mm long, 0.6-0.8 (-1.3) mm wide, entire, ± weakly midribbed, appressed pilose on outer face, glabrous or sparsely pilose on inner face. Secondary bracts membranous, lanceolate to linear-lanceolate, 0.8-1.2 mm long, 0.2-0.3 (-0.5) mm wide, entire, sparsely appressed pilose on outer face only (Fig. 240).

Flowers 4-merous on pedicel 0.3 mm long (Figs. 241, 243, 244). Sepals 4, green, deltoid, 0.5-0.7 mm long, 0.4-0.6 mm wide, margin thickened, prominent median basal callus, glabrous. Petals 4, green to reddish, hooded, keeled, very shortly unguiculate, (2.0-) 2.4-2.8 mm long, 0.7-0.8 mm wide (keel to margin), scabrous on keel. Stamens 8, filament 0.2 mm long; anthers yellow to reddish, linear-oblong, 1.7-2.1 mm long, 0.4 mm wide, 4 locular, nonapiculate, equisized. Styles 4, clavate, 0.4 mm long, stigmas fimbriate. Ovary silver-grey to black, ovoid, 0.8-1.0 mm long, 0.9-1.0 mm wide, 8-ribbed, with 2-3 oblique calluses between ribs, glabrous or scabrous; incompletely 4-locular, 1 ovule per locule.

Fruit on pedicel 0.3-0.5 mm long, silver-grey, ovoid, 1.0-1.3 (-1.5) mm long, 1.0-1.1 (-1.3) mm wide, 8-ribbed, with 2-3 oblique calluses between ribs, glabrous or sparsely scabrous on ribs and calluses; sepals persistent, erect, styles reflexed between or enclosed, deltoid, (0.5-) 0.7-0.9 mm long, 0.6 mm wide, margins thickened, prominent median basal callus; pericarp membranous, 1 seed (Fig. 242).

DISTRIBUTION: *G. tetragynus* is widespread and common in eastern and south-eastern Australia, including Tasmania (Fig. 239). Records of this species from outside of Australia appear in many early publications, as the result of misidentification of *G. incanus* and *G. montanus* (New Zealand) and of *G. chinensis* and *G. philippinensis* (Malesia and south-east Asia to the Khasia Mountains).



Figs. 239-244. *Gonocarpus tetragynus.* 239. Distribution. 240. Inflorescence. 241. Fully bisexual flower. 242. Fruit (figs. 240-242 from *Shaw 723*). 243, 244. Functionally female flowers, 243 in bud, 244 with stigmas receptive (figs. 243, 244 from *Shaw 722*). Scales represent 1 mm (figs. 240-244).

ECOLOGY: This species is usually found in the understory of open *Eucalyptus* forest, often in indifferent soils, at altitudes up to about 1500 m. Typical collectors' notes include "in open dry sclerophyll *Eucalyptus* woodland, on hillside amongst dolerite rock" (*Barker 919*); "wet sclerophyll forest" (*Barker 1523*); "sandy soil with *Xanthorrhoea* and *Leptospermum*" (*Darbyshire 28*); "stony hillside cleared for planting of *Pinus*" (*Evans 2574*); "common on open patches in roadside pasture" (*Hoogland 3047*); "on steep ridge in medium forest with sparse ground cover; soil shaly" (*Muir 1648, 1649*); "besides road in remnants of heathland; undulating country, mainly farmland" (*Muir 2712*); "growing from beneath old fallen logs, on gently sloping granite hillside, *Eucalyptus pauciflora* woodland, ground gravelly with sparse cover of *Poa* and prostrate shrubs" (*Rodd & Coveny 891*). Flowering occurs from October until January, fruiting from October to April (or rarely, until June).

SPECIMENS EXAMINED:

QUEENSLAND: Bailey s.n., -.x.1874, Maroochy River, BRI080104 (fl., fr.); *Bailey s.n.,* 20.ii.1891, Stanthorpe, BRI080106 (fr.); *Blake 23699,* 3.xi.1971, Girraween National Park near Wyberba and Wallangarra, BRI (fl., fr.); *Dietrich s.n.,* 1863-1865, Brisbane River, BRI015164 (fl.); *Everist & Webb 1328,* 22.xi.1946, The Summit, Darling Downs, CANB (fl., fr.); *Hubbard 4097,* 20.ix.1930, near Woodridge, BRI (fl.); *Jones s.n.,* 7.xii.1961, Daves Creek country, Binna Burra, BRI041396 (fl., fr.); *Kenny s.n.,* Gympie, BRI080109 (fl., fr.); *Wedd 217,* -.x.1891, Wellington Point near Brisbane, BRI (fl.); *White s.n.,* -.i.1915, Eumundi, BRI080101 (fr.). *NEW SOUTH WALES: Atkinson s.n.,* near Lomah, Blue Mountains, MEL39404 (fr.); *Baeuerlen 148,* -.xi.1886, Braidwood

district, MEL (fr.); *Baeuerlen 296*, -.xii.1886, Bombala, MEL (fr.); *Baeuerlen 348*, -.i.1885, Braidwood district, MEL (fr.); *Beckler s.n.*, -.x.1859, -.iv.1860, Hastings River to Richmond River, M (fl., fr.); *Beckler s.n.*, Hastings River, MEL39368, 39409, 39410 (fl., fr.); *Betche 50*, 1884, Port Jackson, MEL (fl.); *Betche s.n.*, -.i.1887, Blue Mountains, NSW99336 (fr.); *Betche s.n.*, -.ii.1891, Wallangra, NSW99342 (fl., fr.); *Betche s.n.*, -.ii.1897, Yarrogobilly Caves, NSW99329 (fr.); *Blakely s.n.*, -.xii.1899, Jenolan Caves, AK72971, NSW99350 (fr.); *Blakely s.n.*, -.xi.1907, Bowan Park, NSW99090, 99335 (fl., fr.); *Blakely s.n.*, -.x.1914, Hornsby, NSW99343 (fr.); *Boorman s.n.*, -.xi.1906, Molong, AD96921183 (fr.); *Boorman s.n.*, -.xii.1907, Orange, NSW99348 (fr.); *Boorman s.n.*, -.x.1916, Gilmore near Tumut, NSW99330 (fl.); *Bouton 6*, 20.xi.1890, Upper Lachlan River, MEL (fl., fr.); *Brown 4419*, Port Jackson, MEL (fl.); *Burbidge 3049*, 3.xii.1954, 13 miles [21 km] from Cotter on Cotter-Tharwa road, CANB (fl., fr.); *Burbidge 6847*, 7.xii.1960, between Pig Hill-Dingo Dell Flats, CANB, NSW (fl., fr.); *Burgess s.n.*, 25.iv.1961, Cooma, CBG009362 (fr.. terat.); *Burgess s.n.*, 18.i.1962, Tuggeranong, CBG015573 (fr.); *Calvert s.n.*, Cavan near Yass, MEL39380, 39381 (fr.); *Camfield s.n.*, -.xi.1899, Kogarah, AD96921182 (fl., fr.); *Camfield s.n.*, 10.xi.1902, Carleton to Sans Souci road, NSW99333 (fr.); *Camfield s.n.*, 6.x.1902, Hurstville, AD96921192, NSW99334 (fr.); *Camfield s.n.*, -.xii.1908, Katoomba, NSW99338 (fr.); *Canning 3052*, 16.xii.1969, Tidbinbilla Flora and Fauna Reserve, CBG (fl.); *Carter 12*, 1892, Stewarts Brook, Scone, MEL (fr.); *Cheel s.n.*, Burrenjuck, NSW99022 (fr.); *Cleland s.n.*, -.x.1915, Kew, AD96905117 (fl.); *Constable s.n.*, 29.xii.1959, Narrow Neck Peninsula, AK91773, NSW53349 (fr.); *Coveny s.n.*, 9.ix.1967, between Killabakh Ck. and Mt. Gibraltar, NSW132761 (st.); *Crawford 398*, -.i.1885, Moona Plains, Walcha, MEL (fl., fr.); *Crawford s.n.*, 27.xii.1963, Gilgai, CBG015576 (fl., fr.); *Darbyshire 28*, 15.xi.1960, lower slopes of Mt. McDonald above Murrumbidgee River, CANB (fl., fr.); *Evans 2574*, 8.xii.1966, Kowen Forest, AD, BISH, BRI, CANB, MEL (fl., fr.); *Evans 2652*, -.i.1928, Blackheath, CANB (fr.); *Fawcett 48, 66*, 1884, Bulladelah, MEL (fl., fr.); *Fischer s.n.*, 1889, 1890, Pleasant Hills, MEL39374, 1003746 (fl., fr.); *Fitzgerald s.n.*, 1890, McLeay River, MEL39385 (terat.); *Fletcher s.n.*, -.x.1889, nr. Wagga, NSW99347 (fl., fr.); *Ford s.n.*, 10.i.1958, ca 11 miles [18 km] S.W. of Ebor on Wollombi road, NSW99332 (fr.); *Ford s.n.*, 6.i.1959, Tantawangalo Mt., NSW99024 p.p. (fl., fr.); *Ford s.n.*, 9.i.1959, 1 mile [2 km] S. of Geehi River Crossing, NSW99325 (fr.); *Fraser s.n.*, 1934, Pennant Hills, NSW99341 (fl.); *Gauba s.n.*, 3.xii.1949, Black Mountain, AD96911104, CBG013187 (fr.); *Gauba s.n.*, 27.xii.1949, Black Mountain, AD96911105, CBG013186 (fr.); *Gauba s.n.*, 19.xi.1952, Canberra Botanic Garden, CBG013188 (fl., fr.); *Gaudichaud s.n.*, Port Jackson, P (fr.); *Gibson s.n.*, 3.i.1953, Captains Flat, NSW99326 (fl., fr.); *Goode 430*, 9.x.1961, National Park, nr. road from Andley to Wattamolla, NSW (fl.); *Gregsen s.n.*, -.xii.1901, Mt Wilson, NSW99340 (fl.); *Hartley 134*, 3.xii.1943, Black Mountain, CANB (fl.); *Hickey 122*, -.i.1885, Maryland, MEL (fl., fr.); *Hoogland 3047*, 6.xii.1952, Paddy's River District, ca 3 miles [5 km] N. of Tharwa, CANB (fr.); *Johnson s.n.*, 11.x.1953, Karuah, AD96921185 (fl.); *Johnson s.n.*, 12.x.1953, 2 miles [3 km] W. of Karuah, AD96921189 (fl., fr.); *Johnson s.n.*, -.x.1964, R.A.N. Armament Depot, Newington, NSW99012 (fl.); *Knoetzsch s.n.*, -.x.1884, New England, MEL39386 (fl.); *Lumsden s.n.*, -.xi.1906, West Goulburn, NSW99331 (fr.); *Mair s.n.*, 21.x.1951, Abercrombie Caves, NSW99346 (fl.); *MacBarron 2735*, 5.xii.1948, Monument Hill, Albury, NSW (fr.); *McBarron 2788*, 16.xii.1948, Bell's Road, Gerogery, NSW (fr.); *McBarron 2878*, 29.xii.1948, The Glen via Tumbarumba, NSW (fr.); *McDonnell 184*, 25.xi.1969, Black Mountain, CBG (fr.); *McKee 7693*, 10.xii.1960, O'Connor, A.C.T., CANB (fr.); *Moore s.n.*, 25.xi.1948, 22.9 miles [36.5 km] from Canowindra on road to Orange, CANB54680 (fl.); *Moore M6*, 20.xi.1945, Yass-Boorowa, CANB (fl., fr.); *Moore 2173*, 16.xii.1952, Burrinjuck road, CANB (fl., fr.); *Moore 2768*, 10.xi.1953, 18 miles [29 km] from Canberra on Yass road, CANB (fl., fr.); *Moore 2826*, 10.xii.1953, Goulburn-Crookwell, CANB, NSW (fl., fr.); *Moore 3151*, 25.iii.1959, 6 miles [10 km] Yass side of Murrumbateman, CANB (fr.); *Norland s.n.*, -.xii.1947, Tumut-Tumbarumba-Holbrook, NSW99023 (fr.); *Orchard 2388*, 28.x.1969, ca 6 km south of Coffs Harbour, AD (fr.); *Orchard 2394*, 29.x.1969, bridge over River Corang on Nerriga-Braidwood road, AD (fl.); *Patterson s.n.*, -.x.1916, Albury, NSW99091 (fl.); *Perrott 120*, Armidale, MEL (fr.); *Phillips & Carroll s.n.*, 27.x.1965, 13 miles [21 km] from Khancoban near Yellow Bay, CBG019688 (fl.); *Pullen 18*, 21.xii.1956, Black Mountain, CANB (fr.); *Pullen 2308*, 3.xi.1960, Black Mountain, CANB, NSW (fl.); *Pullen 4177*, 10.xi.1966, Tallowa Sanctuary, Morton Nat. Park, E. of Tallong, CANB (fr.); *Ramsey s.n.*, -.xi.1898, Barbers Creek, AK72969, NSW99089 (fl., fr.); *Reiner 404*, 3.x.1960, Flat Rock Creek, Tomerong, CANB (fl.); *Rodd 309*, 10.iv.1966, ca ¾ mile [1 km] N. of The Blue Waterhole, Cave Creek, NSW (fr.); *Rodd 850*, 8.iv.1969, near junction of Cave Creek and Goodradigbee R., NSW (st.); *Rodd & Coveny 891*, 11.xii.1969, Cave Creek, ½ mile [1 km] below The Blue Waterhole, NSW (fl.); *Rodd & Coveny 931*, 12.xii.1969, ¼ mile [½ km] N.W. of The Blue Waterhole, NSW (fl.); *Rodway s.n.*, 1.xi.1925, Huskisson, Jervis Bay, NSW99317 (fl., fr.); *Rodway s.n.*, 28.xi.1951, Nowra, NSW98879 (fl., fr.); *Rodway s.n.*, 15.x.1952, Nowra, NSW99324 (fl., fr.); *Rodway 223*, 30.xi.1930, Fitzroy Falls, NSW (fl., fr.); *Salasoo 2798*, 2.i.1964, ca 3 miles [5 km] N.N.E. of Wingham, NSW (fl.); *Salasoo 3457*, 22.i.1969, 20 miles [32 km] from Tumut towards Talbingo, NSW (st.); *Schwartz s.n.*, Ash Island [Hunter River], W (fl., fr.) — lectotype of *H. tetragyna* var. *decumbens*; *Smith M109*, -.xi.1943, Walcha, BRI (fr.); *Stuart s.n.*, New England, MEL39367, 39407, 39408 (fl., fr.); *Tennison-Woods s.n.*, 30.xii.1882, Wentworth Falls, BRI080116 (fl., fr.); *Walker ANU1002*, -.i.1963, east bank of Queanbean River, CANB, NSW (fl., fr.); *Woolls s.n.*, Paramatta, MEL39358-9 (fl., fr.). *VICTORIA: Allitt s.n.*, mouth of the Glenelg, MEL39326 (fr.); *Anderson 282*, 22.x.1968, 1½ miles [2.5 km] north of Warrandyte along Blooms Road, MEL (fl., fr.); *Aston 435*, 20.x.1959, 15 miles [24 km] N.N.E. of Bendigo along the Huntly-Kamarooka road, MEL (fl., fr.); *Aston 997*, 29.ix.1963, 2 miles [3 km] east of the Kaniva-Booroopki road, MEL (fl.); *Barker 1447*, 27.x.1971, ca 15 km N.N.E. of Gymbowan on the road to Nhill, AD (fl., fr.); *Barker 1523*, 26.xii.1971, on the steep lower east slopes of Mt. Tamboritha, AD (fl., fr.); *Barker 1608*, 11.i.1972, at the turnoff to Limestone Hut on the Benambra-Cobberas-Wulgulmerang road, AD (fr.); *Brumby 5*, 1888, Goulburn River, MEL (fl); *Burbidge 3*, 1878, Ballarat, MEL (fl., fr.); *Canning 255*, 27.x.1967, 4 miles [6 km] from Springhurst along road to Town Water Storage dam, CBG (fl.); *Carroll s.n.*, 18.xii.1965, 2 miles [3 km] from Suggan Buggan towards Wulgulmerang, CBG015134 (fr.); *Carroll s.n.*, 6.xi.1966, "Hillcrest", Hillcrest Avenue, Eltham, CBG017527 (fl.); *Cullimore 210*, 16.i.1968, 10.6 miles [17 km] north of Dargo on road to Grant, AD, MEL (fl., fr.); *Curdie s.n.*, Donald, MEL39355 (fl.); *Davis s.n.*, 30.ix.1942, Seymour, NSW99028 (fl.); *Day s.n.*, 1875, near Ballarat, MEL39338 (terat.); *Deane s.n.*, -.i.1900, Blacks Spur, NSW99042 (fr.); *Donnor 3401*, 1.i.1970, Loch River, near Noojee, AD (fr.); *Fullagar s.n.*, Little River, MEL39347 (fl.); *Fuller s.n.*, Barnawartha, MEL39348 (fl., fr.); *Gargurevich s.n.*, 1874, Red Jacket Creek, MEL39349 (fr.); *Gates 41*, 1890, Upper Goulburn River, MEL (fl., fr); *Green 108*, Ararat, MEL (fr.); *Hardy s.n.*, 1882, Goulburn River, MEL39369 (fl., fr.); *Hendimming 110*, Ballarat, MEL (fr.); *Hewitt s.n.*, 1882, Gippsland,

MEL39327 (fr.); *Ising s.n.*, 20.ix.1969, Warby Range 6 km east of Wangaratta, AD97037178 (st.); *Jephcott s.n.*, 1883, Hume River, MEL39330 (fl., fr.); *Jephcott 62*, 1882, Hume River, MEL (fl., fr.); *Jephcott 64*, 1878, Hume River, MEL (fl., fr.); *Johnstone s.n.*, Meredith, MEL39356 (fr.); *Maiden s.n.*, -.i.1900, Mt Hotham, NSW99044 (fr.); *Matthews 71*, 1893, Stawell, MEL (fl.); *Mauritzon s.n.*, 17.x.1936, Ringwood, UPS (fl.); *Meebold s.n.*, -.i.1937, Frankston, NSW99033 (fr. — terat.); *Meebold 2029*, -.xii.1928, Cardinia, M (fr.); *Meebold 2182*, -.i.1929, Grampians, M (fr.); *Meebold 6075*, -.xi.1929, Parkenham, M (fr.); *Merrah s.n.*, 1887, Bendoc to Bonang, MEL39512 (st.); *Merrah s.n.*, -.xi.1887, sources of the Brodribb River, MEL1003734 (fl.); *Minchin s.n.*, 1886, Port Phillip, MEL1003713 (fl.); *Morrison s.n.*, 3.xii.1892, Bayswater, CANB127121, PERTH (fr.); *Morrison s.n.*, 24.xii.1892, Ringwood, AD96412051, BRI078859, CANB127120, PERTH (fl., fr.); *Morrison s.n.*, 2.xi.1893, Croydon, AD96412052, BRI078860, CANB127119, PERTH (fr.); *Morrison s.n.*, 11.xi.1893, Oakleigh, CANB 127118 (fl.); *Mueller s.n.*, Port Phillip, MEL1003790, P (fl.); *Mueller s.n.*, Victoria, BRI080110, P (fl., fr.); *Mueller s.n.*, Upper Yarra, PR (fr.); *Mueller s.n.*, Wimmera, MEL39336 (fl., fr.); *Muir 586*, 11.xii.1958, Heatherdale, MEL (fr.); *Muir 708*, 21.i.1959, Wilkinson Memorial Hut, Bogong High Plains, UPS (fr.); *Muir 1442*, 13.x.1960, Strathbogie Ranges, MEL (fl.); *Muir 1459*, 15.x.1960, Cosstick Reserve, 2 miles [3 km] west of Maryborough, MEL (fl.); *Muir 1648, 1649*, 31.x.1960, near Fryers Creek on the Jamieson road about 26 miles [42 km] from Eildon, MEL (fl., fr.); *Muir 1713, 1714*, 1.xi.1960, near Killawarra, MEL (fl., fr.); *Muir 2013, 2014*, 11.xii.1960, beside Ferntree Gully railway line ½ mile [1 km] east of Ringwood, MEL (fl., fr.); *Muir 2712*, 4.xi.1962, 2 miles [3 km] east of Lah-arum, MEL (fl., fr.); *Muir 2948*, 31.xii.1963, Nightingale Creek, just above Tali Karng, MEL (fr.); *Muir 3546*, 27.x.1964, 5 miles [8 km] south of Highlands on Yea road, MEL (fl.); *Nelson ANU16341*, -.i.1972, Point Addis near Angelsea, CANB (fr.); *Orchard 1881*, 7.ii.1969, ca 1 km south of junction of Victoria Valley road and Jensens Road, Grampians, AD (fr.); *Orchard 1912*, 9.ii.1969, Moora Channel inlet at junction of Moora Track and Victoria Valley Road, AD (fr.); *Orchard 1964*, 11.ii.1969, Dwyer's Creek on Halls Gap-Dunkeld road, AD (fr.); *Orchard 1970*, Halls Gap-Dunkeld road, ca 3 km north of Victoria Valley Hall, AD (st.); *Orchard 2009*, 13.ii.1969, "The Jackass" on Fitzroy River, AD (fr.); *Orchard 2514*, 26.viii.1970, near Little River Gorge, AD (st.); *Orchard 2673*, 5.xii.1970, Mt Wheeler, AD (fl., fr.); *Orchard 2757*, 6.xii.1970, ca 4 km east of Mt Seldom Seen, AD (fl.); *Orchard 2782*, 6.xii.1970, Bald Hill, above headwaters of Boundary Creek, Wulgulmerang, AD (fr.); *Phillips s.n.*, 21.ix.1961, Tarnagulla, on Growlers Hill, CBG015616 (fl.); *Phillips s.n.*, 21.ix.1961, Whipstick Scrub, N. of Bendigo, CBG016740 (fl.); *Phillips s.n.*, 30.x.1963, near Dunolly on Murderers Hill, CBG015617 (fl., fr.); *Phillips s.n.*, 22.x.1966, 27 miles [43 km] from Kaniva on Boundary Road, AD96911106, CBG019639 (fl., fr.); *Phillips 15*, 19.x.1971, 22 miles [35 km] from Benalla towards Mansfield, CBG (fl.); *Pye 33*, 1889, Lower Goulburn River, MEL (fl.); *Reader s.n.*, 29.viii.1883, Standley Park, MEL39352 (fl.); *Reader s.n.*, 3.xi.1892, Shire of Dimboola, MEL39331 (fl., fr.); *Reader 10, 11, 12*, 1892, Wimmera, MEL (fl., fr.); *Rourke 60*, 1883, Wulgulmerang, MEL (fr.); *Salasoo 1749*, 2.i.1959, Fern Tree Gully, NSW (fr.); *Sayer s.n.*, 1887, Bemm River, MEL39516 (fr.); *Smith M8*, 24.i.1943, Dandenong Range below Kalorama, BRI (fr.); *Spence s.n.*, 1885, east of Ballarat, MEL39342 (st.); *Sullivan s.n.*, -.xi.1879, Moyston, MEL39351 (fl.); *Symon 1649*, 30.x.1961, ± 7 miles [11 km] N.W. of Zumsteins on main road to Horsham, ADW (fl., fr.); *Symon 1710*, 1.xi.1961, 4 miles [6 km] N. of Wannon Bridge on the Dunkeld-Halls Gap road, ADW (fl., fr.); *Tilden 1016*, -.xii.1912, Halls Gap, BISH (fr.); *Toepffer 102*, 24.xii.1886, between Healesville and Fernshaw, MEL (fr.); *Walter s.n.*, Wimmera, MEL39251, NSW87861 (fl.) — isotypes of *H. rubra*; *Walter s.n.*, Grampians, CANB190872, P (fr.); *Walter s.n.*, 1881, Upper Yarra, M, P, PR (fl., fr.); *Walter s.n.*, -.xi.1897, Dandenong Ranges, NSW99043 (fr.); *Watts 1291b*, -.x.1918, near Wedderburn, MEL (fl.); *Wawra 542*, 1872/3, Dandenong, NSW (st.) — isotype of *H. tetragyna* var. *serrata*; *Weatherhead s.n.*, 1883, Nungatta, Genoa, MEL39494 (fr.); *Whan s.n.*, Skipton, NSW99046 (fl.); *Whan 198*, Creswick, MEL (fr.); *Wilson s.n.*, 1890, Murray River near Albury, MEL39321 (fl., fr.); *Wilson 50*, 1885, near Geelong, MEL (fl.); *Wilson 98*, 1881, Geelong, MEL (fr.); *Williamson s.n.*, -.xi.1901, Hawkesdale, AK72970, NSW99045 (fr.); *Williamson 28*, 1893, Hopkins River, MEL (fl., fr.). *SOUTH AUSTRALIA: Alcock 2881*, 3.xi.1969, south-east corner, Big Heath National Park, AD (fl., fr.); *Alcock 2921*, 4.xi.1969, Big Heath National Park, AD (fl., fr.); *Alcock 3160*, 17.xi.1969, Big Heath National Park, AD (fl., fr.); *Barker 874*, 19.x.1970, ca 22 miles [35 km] by road west of Victor Harbour, AD (fl.); *Belcher 564*, 31.x.1967, shoulder of Mengler's Hill, Barossa Range, AD (fl., fr.); *Blandowski s.n.*, 1850, Port Adelaide, MEL39428 (fl.); *Black 17*, -.xi.1903, Port Lincoln, NSW (fl., fr.); *Butler s.n.*, -.x.1947, Mt. Lofty, ADW6671 (fl., fr.); *Cleland s.n.*, Morialta, AD97223033 (fl.); *Cleland s.n.*, -.ix.1918, Kuitpo, AD96803099 (fl.); *Cleland s.n.*, 3.x.1920, Clarendon, AD96803113 (fl.); *Cleland s.n.*, 7.i.1923, Encounter Bay, AD96803115 (fr.); *Cleland s.n.*, 31.viii.1924, Encounter Bay, AD96803097 (st.); *Cleland s.n.*, 18.xi.1924, Rocky River, AD96803067 (fl., fr.); *Cleland s.n.*, 5.iii.1926, Squashy Creek, AD96803112 (st.); *Cleland s.n.*, 21.vi.1928, Kuitpo, AD968020437 (fr.); *Cleland s.n.*, 23.ix.1928, Kuitpo, AD96803089 (st.); *Cleland s.n.*, 31.x.1928, Aldinga Beach scrub, AD96808371 p.p. (fl., fr.); *Cleland s.n.*, -.i.1929, Upper Hindmarsh Valley, AD96803066 (fr.); *Cleland s.n.*, 16.i.1932, Hindmarsh Tiers, AD96803116 (fr.); *Cleland s.n.*, -.i.1933, Hindmarsh Tiers, AD96803095 (fr.); *Cleland s.n.*, 17.xii.1935, National Park, AD96803086 (fl., fr.); *Cleland s.n.*, 30.xii.1935, National Park, AD96803093 (fl.); *Cleland s.n.*, 18.xii.1939, National Park, AD96803107 (fr.); *Cleland s.n.*, 3.xi.1941, Point Douglas, AD96803091 (fl.); *Cleland s.n.*, 8.i.1942, Encounter Bay, AD96803098 (fr.); *Cleland s.n.*, 14.xi.1942, National Park, AD966032566, 96803114 (fl., fr.); *Cleland s.n.*, 14.i.1952, Cape Jervis Road, AD96803085 (st.); *Cleland s.n.*, 27.xi.1954, head of South-West River, AD968020569 (fl., fr.); *Cleland s.n.*, 28.xi.1954, Rocky River, AD968020572 (fr.); *Cooper s.n.*, 28.xii.1942, ca 8 km north of Tungkalilla beach, AD96229003 (terat.); *Copley 2844*, 11.x.1969, Carpenters Rocks ca 35 km N.W. of Port MacDonnell, AK (fl.); *Czornij 53*, 27.x.1966, 2 km south of Meadows, AD (fl., fr.); *Czornij 663*, 10.x.1973, Mount Remarkable, AD (fl.); *Dodsen 170*, 15.ix.1972, Mt. Burr, AD (st.); *Eardley s.n.*, 17.x.1936, Mt Compass, ADW2459 (st.); *Eichler 20499*, 10.xi.1968, National Park, Belair, AD (fl.); *Gill 68*, 1889, Wirrabara Forest, MEL (fl., fr.); *Hilton 1174*, 23.xii.1964, between Little Mount and Mt. Lofty, ADW (fl., fr.); *Hunt 178*, 9.x.1961, Bool Lagoon-Lucindale road, AD (fl., fr.); *Hunt 1600*, 9.ix.1963, between Padthaway and Keith, AD (fl., fr.); *Hunt 1620*, 27.x.1963, "The Gap" between Naracoorte and Bool Lagoon, AD (fl., fr.); *Hunt 2160*, 4.x.1964, Julia Hill, Penola Forest, AD (fl.); *Hunt 2712*, 15.x.1966, near Black Swamp, Finnis, AD (fl.); *Hunt 2943*, 9.i.1969, Waitpinga, AD (fr.); *Hunt 2948*, 11.i.1969, Hindmarsh Valley, AD (fr.); *Hunt 2949*, 13.i.1969, Hindmarsh Falls area, AD (fr.); *Hunt 2951*, 13.i.1969, Waitpinga, AD (fr.); *Hunt 2962*, 19.i.1969, Hahndorf AD (fr.); *Hunt 3007*, 29.vi.1969, Inman Valley, AD (fl., fr.); *Hunt 3060*, 12.x.1969, Gum Avenue, Victor Harbour, AD (fl., fr.); *Hunt 3062*, outskirts of Victor Harbour, AD (fr.); *Hunt 3065*, 15.x.1969, Santa

Cruz Scrub, Waitpinga, AD (fl., fr.); *Hunt 3082*, 26.x.1969, Trig Point Hill, Waitpinga area, AD (fr.); *Hunt 3102*, 2.xi.1969, Myponga area, AD (fl.); *Hunt 3110*, 15.xi.1969, Nangkita, AD (fl.); *Hussey s.n.*, -.vii.1895, Port Elliot.AD96211069 (fr.); *Ising s.n.*, 11.xi.1918, Belair, AD966031943 (fl., fr.); *Ising s.n.*, 19.xi.1921, Cherryville, AD966031946 (fl., fr.); *Ising s.n.*, 26.xi.1921, Mt Lofty, AD966031978 (fl., fr.); *Ising s.n.*, 17.xi.1923, Mt. Lofty, AD966031982 (fl.); *Ising s.n.*, 14.xi.1925, Millbrook, AD96803118 (fl.); *Ising s.n.*, 12.xii.1925, Mt. Lofty, ADW16998 (fr.); *Ising s.n.*, 13.x.1926, Myponga, AD966032007 (fl., fr.); *Ising s.n.*, 29.x.1927, Ironbank, AD966032058 (fl., fr.); *Ising s.n.*, 23.x.1928, Alligator Creek, AD96830364 (fl., fr.); *Ising s.n.*, 25.x.1928, Mt. Remarkable, AD966032042 (fl., fr.); *Ising s.n.*, 27.x.1930, Lucindale, AD96830387 (fl.); *Ising s.n.*, -.xi.1930, Mt. Lofty, AD966032010 (fl., fr.); *Ising s.n.*, 4.xi.1933, National Park, Belair, AD966031963, 96803151 (fl., fr.); *Ising s.n.*, 25.xi.1934, Victor Harbour, AD966032026 (fr.); *Ising s.n.*, 14.xii.1934, Stewarts ca 11 km west of Naracoorte, AD96830382 (fr.); *Ising s.n.*, 26.x.1934, Naracoorte, AD96830385 (fl., fr.); *Ising s.n.*, 12.xi.1935, Tintinara, AD96830366 (fr.); *Ising s.n.*, 13.xi.1935, Penola, AD96830361 (fl., fr.); *Ising s.n.*, 5.xii.1968, Crafers, AD96904172 (fl., fr.); *Ising s.n.*, 4.i.1969, Crafers, AD96904162 (fr.); *Jackson 267*, 19.xi.1959, near Ewen Ponds, AD (fr.); *Jackson 677*, 3.xi.1964, Delamere, AD (fl.); *Koch 932*, -.xi.1902, Belair, AK, NSW (fr.); *Kraehenbuel 1245*, 7.xi.1964, ca 20 km north of Wolsely, AD (fl., fr.); *Kuchel 1262*, 16.x.1963, Mt Lofty Botanic Gardens, AD, CHR (fl.); *Meebold 1604*, -.xii.1928, Mt Lofty, M (fl., fr.); *Mueller s.n.*, Mt Lofty Range, MEL39425, 1003676, 1003770, P (fl., fr.); *Mueller s.n.*, Barossa, MEL1003773 p.p., 1003778, P (fl., fr.); *Mueller s.n.*, 10.i.1848, Third Creek, MEL39421 (fr.); *Mueller s.n.*, 1850, between Macclesfield and Willunga, MEL39426 (st.); *Orchard 1803*, 3.xi.1968, ca 5.5 km south of Monarto South, AD (fr.); *Orchard 1810A, 1811*, 3.xi.1968, Tookayerta Creek ca 5 km south-east of Tooperang, AD (fr.); *Orchard 1812*, 15.xi.1968, Jubilee Drive, National Park, AD (fl.); *Orchard 1824*, 21.xi.1968, Montacute Road, ca 1.5 km from Cherryville turnoff, AD (fl., fr.); *Orchard 1834*, 21.xi.1968, ca 3 km east of Basket Range, AD (fl.); *Orchard 2027*, 14.ii.1969, ca 5 km south-east of Glencoe, AD (st.); *Orchard 2076*, 15.iv.1969, Hindmarsh Falls, AD (st.); *Orchard 2184*, 20.ix.1969, Milbrook Reservoir, AD (st.); *Orchard 2192*, 21.ix.1969, Mt Observation, AD (fl., fr.); *Parsons 15*, 27.x.1961, Section 781, Hd. of Kuitpo, AD (fl., fr.); *Rainbox s.n.*, 14.xi.1927, Blackwood, ADW16997 (fr.); *Salasoo 1646*, 27.xii.1958, between Crafers and Aldgate, NSW (fr.); *Shaw 722, 723*, 23.xi.1966, ca 2 km south of Spring Mount trig point, AD (fl., fr.); *Smith 602*, 11.x.1967, ca 4 km north of Happy Valley, AD (fl.); *Smith 803*, 31.x.1967, ca 5 km south of Monarto South, AD (fl., fr.); *Smith 826*, 15.x.1967, Halls Road, Highbury East, AD (fl., fr.); *Smith 921*, 16.x.1967, ca 1 km E.S.E. of township of Hackham, AD (fl.); *Specht and Rayson 57*, -.xi.1950, Dark Island Heath, AD (fl., fr.); *Spooner 480*, 22.x.1969, Torrens Gorge, AD (fl.); *Spooner 1005, 1006*, 6.xii.1970, Finniss Scrub, AD (fr.); *Symon s.n.*, 12.x.1961, Happy Valley Reservoir Reserve, ADW24239 (fl.); *Tate s.n.*, -.x.1880, Uley Scrub, AD96810078 (fl., fr.); *Tate s.n.*, 19.xi.1881, Wirrabarra, AD96810095 (fl., fr.); *Tate s.n.*, 16.xi.1882, Riddock Bay, AD96810112 (fl., fr.); *Tate s.n.*, 24.xi.1883, Belair, AD96810110 (fr.); *Tate s.n.*, -.xii.1883, Mt. McIntyre, AD96810080 (fr.); *Tate 121*, Yallum, AD (fl.); *Tepper s.n.*, 1883, Mount Lofty Ranges, MEL39422 (st.); *Tepper s.n.*, -.xi.1896, Karatta, AD968061230 (fr.); *Tepper 43*, 6-7.i.1882, Square Waterhole, MEL (fl., fr.); *Tepper 111*, -.x.1881, Clarendon, MEL (fl.); *Tepper 253*, 6.xi.1881, Clarendon, MEL (fl., fr.); *Weber 293, 419, 452, 453, 484*, Nov.-Dec. 1966, Mt. Lofty Botanic Garden, AD (fl., fr.); *Weber 1780*, 5.xi.1969, Big Heath National Park, AD (fl., fr.); *Wheeler 107, 129, 257, 264*, Nov.-Dec. 1966, Mt. Lofty Botanic Garden, AD (fl., fr.); *Whibley 447*, 10.xii.1958, Nixon Skinner Reserve, Myponga, AD (fr.); *Whibley 547*, 1.xi.1959, just south of Mt Magnificent, AD (fl., fr.); *Whibley 1355*, 3.xii.1963, Hindmarsh Valley Falls, AD (fr.); *Whibley 2683*, 17.x.1968, corner of Old Mt. Barker Road and Old Carey Gully Road, AD (fl.); *Wilson 436*, 16.i.1966, ca 4 km south-west of Lake Leake, AD, CANB CHR (terat.); *Wilson 626*, 5.xi.1966, ca 1.5 km north of Wandillo Railway Station, AD (fl.); *Wilson 883*, 10.x.1968, Clover Hill, ca 11 km N.E. of Mt Gambier, AD (fl.); *Wilson 1078*, 10.xi.1959, ca 10 km north-north-west of Millicent, AD (fl., fr.); *Wilson 1097*, 11.xi.1959, Mt Burr Forest Reserve, AD (fl., fr.); *Wilson 1205*, 14.xi.1959, Wattle Range, on Penola-Furner road, AD (fl.). *TASMANIA: Archer 80*, South Esk, NSW (fr.); *Barker 919*, 6.xi.1970, Prossers Forest road, ca. 6.5 km south-east of turnoff from Lilydale-Launceston road, AD (fl., fr.); *Barker 937A*, 8.xi.1970, near Saltwater Inlet, AD (fl.); *Barker 986, 987A*, 22.xi.1970, ridge immediately west of Badger Head, AD (fl., fr.); *Barker 1081*, 9.i.1971, River Mersey ca 8 km south of Parangana Dam, AD (fl., fr.); *Bauer s.n.*, in capite van Dieman, W (fr.) — syntype of *H. tetragyna* var. *decumbens*; *Bufton 18*, 1892, Port Arthur, MEL (fl.); *Cleland s.n.*, -.xi.1912, Flinders Island, NSW103118 (fl., fr.); *Curtis s.n.*, 9.x.1942, Hobart, CHR180361 (fl.); *Curtis s.n.*, -.x.1943, Cataract Gorge, Launceston, HO6675 (fr.); *Curtis s.n.*, 11.xii.1952, Westerway, Derwent Valley, HO6674 (fl., fr.); *Gunn s.n.*, 1863, Tasmania, G (herb. DC., Boiss.) (st.) — isosyntypes of *H. tetragyna* var. *decumbens*; *Gunn s.n.*, Tasmania, CGE, MEL1003772, P (2 sheets) (fl., fr.); *Gunn 85*, 20.xii.1837, Circular Head, NSW (fl., fr.); *Gunn 85*, 3.xii.1841, Port Effingham, AK, NSW (fl., fr.); *Gunn 85*, 1842, N. Norfolk, CGE (fr.); *Gunn 884*, 31.i.1840, Mt Wellington, NSW99136 p.p. (fr.); *Hooker s.n.*, Circular Head, U118392B (fr.); *Hooker s.n.*, Tasmania, PR, UPS (fl., fr.); *Jackson s.n.*, -.i.1954, Long Plains, Corinna, HO6673 (fr.); *Johnson s.n.*, 15.i.1949, S. of Eaglehawk Neck, NSW103148 (fr.); *Labillardiere s.n.*, Nouv. Holl., G (fr.) — lectotype of *G. tetragynus*; *Lindley s.n.*, 1839, Van Diemens Land, G, W (fl., fr.) — isosyntypes of *H. tetragyna* var. *decumbens*; *Long 114*, 1.ii.1930, nr. Longley, HO (st.); *Lucas s.n.*, -.xii.1923, Glenorchy, NSW99039 (fl., fr.); *Mueller s.n.*, V.D. Land, MEL1003773 p.p. (fl., fr.); *Oakden 21*, -.xii.1885, near Launceston, MEL (fl., fr.); *Phillips s.n.*, 18.i.1962, Mt. Tim Shea, Florentine Valley, CBG015441 (fr.); *Phillips s.n.*, 29.i.1962, near Mathinna, CBG015445 (st.); *Phillips s.n.*, 17.xi.1965, 2 miles [3 km] from Arthur River towards Marrawah, AD97033043, CBG033909 (fl.); *Phillips s.n.*, 29.xi.1965, between Barnes Bay and Dennes Point, North Bruny Island, CBG014175 (fl., fr.); *Phillips s.n.*, 7.xii.1965, Upper Scamander road, CBG020341 (fl., fr.); *Rodway s.n.*, -.i.1896, Cascades, Hobart, HO6665 (fl.); *Rodway s.n.*, -.i.1916, Bellerive, NSW99031 (fr.); *Rodway s.n.*, -.i.1918, Mt. Nelson Range, NSW99030 (fr.); *Rodway s.n.*, -.xi.1928, Blackman's Bay, HO6664 (fl.); *Rodway 1*, 7.i.1931, Sandfly, CANB, HO (fr.); *Rodway 204*, -.xii.-, Mt. Nelson, HO (fr.); *Rodway 2042*, 29.xi.1935, Blackman's Bay, NSW (fl., fr.); *Rodway s.n.*, Hobart, HO6663 (fr.); *Simson s.n.*, near Georges Bay, Launceston, BRI080102 (fl., fr.); *Somerville s.n.*, 5.vi.1963, River Derwent — gorge at Meadow Bank H.E.C. dam, HO7227 (st.); *Spicer s.n.*, Tasmania, AK72973 (fl., fr.); *Stuart s.n.*, Van Diemensland, G (fl., fr.); *Stuart 1708*, -.i.1856, Southport, MEL (fr.); *Thomson s.n.*, Hobart, CHR114020 (fr.); *Unwin 22*, 13.i.1931, Meander, CANB (st.); *Whaite & Whaite 2317*, 24.i.1961, Rearing Beach, 6 miles [10 km] E. of Dover, NSW (fr.); *Whaite & Whaite 2975*, 24.x.1965, 10 miles [16 km] S. of Sassafras, NSW (fl., fr.).

The specimen cited above as the type of *G. tetragynus* was annotated "Das einzige mir bekannte Original" by Schindler, thus effectively choosing this specimen (in G.) as lectotype. This plant is a good match with Labillardiere's original illustration, and agrees well with current concepts of the species. However there are other Labillardiere collections from Tasmania in P (herb. DC) and FI (2 sheets — herb. Webb ex herb. Desfontaines and ex herb. Labillardiere) which do not represent this species. They are all *G. teucrioides*, although one formed the basis of de Candolle's "*G. tetragynus* Labill." in the Prodromus (1828). The epithet *tetragynus* has been misapplied to a wide range of species, including *G. chinensis, G. philippinensis, G. incanus, G. montanus, Haloragis glauca* and *G. elatus* x *G.* sp. Details are given under the species concerned. Schindler (1905) recognised 6 varieties under this species, which gives some measure of its variability. However this variation shows no geographical pattern and is probably to a large extent the result of introgression with associated species such as *G. elatus, G. teucrioides, G. mezianus* and *G. humilis*. Schindler's varieties do not adequately describe the pattern of this variation, nor are they always easily distinguished. It has therefore seemed advisable to dispense with infra-specific categories in this case until such time as an intensive study of the variation and breeding system of *G. tetragynus* can be made throughout its range.

Only the typical forms (comprising about 95% of collections) of the species are covered by the above description. Only two types of deviations from this will be mentioned. The first concerns the indumentum. Typical specimens of *G. tetragynus* can be distinguished from most other species of *Gonocarpus* by their regular, moderately dense, appressed hairs on stems and leaves. In some specimens, perhaps as the result of introgression, the hairs become more or less spreading, and it was extreme examples of this which probably formed the basis of Schindler's *H. tetragyna* var. *hispida* and *H. tetragyna* var. *lanceolata*. The other common deviation from the description concerns the flowers. As in several other species, plants are known in which the flowers are functionally female, by the abortion of the petals and stamens. Schindler's *Haloragis rubra* is based on such a plant. The phenomenon is random in occurrence; *Shaw 722* (female) and *Shaw 723* (bisexual) were collected alongside each other, as were *Muir 1648* (female) and *Muir 1649* (bisexual). Many similar cases are recorded (Figs. 243, 244).

13. **Gonocarpus implexus** Orchard (Figs. 245-250)

Gonocarpus implexus Orchard, sp. nov.

Herba infirma diffusa, usque ad 40 cm altam; caules herbacei decumbentes profuse ramosi implexi ad nodos inferiores radicantes 4-angulati strigosi pilis 0.3 mm longis.

Folia remota decussata sessilia ovata ad orbicularia 6-11 mm longa, 6-10 mm lata, lamina tenuis grosse serrata dentibus (3-) 7-9 patentibus anguste cuspidatis 1-2 mm longis basis rotundata ad subcordatam nervi indistincti, strigosa in superficiebus ambabus.

Inflorescentia spica indeterminata florum portatorum singulatim in axillas bractearum primarium alternarum. Inflorescentiae laterales in axillas foliorum superiorum. Bracteae primariae virides lineares ad anguste deltoideas 1.1-1.4 mm longae, 0.4-0.5 mm latae integrae margine incrassato strigosae in superficie abaxiali. Bractae secundariae virides lineares ad anguste lanceolatas 0.7-1.1 mm longae 0.2-0.3 mm latae integrae margine incrassato glabrae.

Sepala 4, viridia deltoidia (0.5-) 0.6-0.7 mm longa (0.3-) 0.4-0.6 mm lata, margines incrassatae apex acutus, plusminusve saccata ad basim glabra. Petala 4 cucullata carinata unguiculata 0.9-1.3 mm longa, 0.4 mm lata (carina ad marginem), scabra in carina. Stamina 8, filamenta 0 2 mm longa; antherae luteae anguste oblongae (0.5-) 0.6-0.8 mm longae, 0.2 mm latae, 4-cellularis nonapiculatae. Styli 4, clavati 0.2 mm longi; stigmata capitata. Ovarium turbinatum (0.6-) 0.8-0.9 mm longum, (0.5-) 0.8-0.9 mm latum, 8-costatum callis 3 lateralibus centris in costis antipetalis, glabrum, incomplete 4-loculare, ovulum 1 per loculum.

Fructus argenteus ad cinereum, cylindricus ad obovoideum (0 7-) 1.0 mm longus, (0.6-) 0.9 mm latus 8-costatus longitudinaliter callis 3 (-4) lateralibus centris in costis antipetalis, costae antisepalinae tuberculiis ca 5 minutis, glaber; sepala persistentia, viridia erecta styli includens deltata ad cordata 0.6-0.7 mm longa 0.5 mm lata, glabra; semen unum.

Typus: D. E. Symon 7113, 30.v.1971, Longini Landing, Kalumburu Mission, Lat. 14°15′S, Long. 126°36′E. Banks of small creekline in grass, etc. (fl., fr.); Holotypus: AD97126008 (Fig. 245). Isotypi: ADW; three others to be distributed.

Weak scrambling herb, up to 40 cm tall, mat-forming; stems herbaceous, decumbent, profusely branched, tangled, rooting at lower nodes, 4-angled, strigose with simple, white, appressed unicellular hairs 0.3 mm long.

Leaves distant, decussate, sessile, ovate to orbicular, 6-11 mm long, 6-10 mm wide, lamina *(in sicco)* thin, membranous, coarsely serrate with (3-) 7-9 spreading narrow-cuspidate teeth 1-2 mm long, base rounded to subcordate, veins indistinct, strigose on both faces with hairs as for stems.

Fig. 245. Holotype of *Gonocarpus implexus*.

Figs. 246-250. *Gonocarpus implexus.* 246. Distribution. 247. Upper part of inflorescence. 248. Flower. 249. Fruit, with primary and secondary bracts. 250. Fruit. (figs. 247-250 from *Symon 7113*). Scale represents 1 mm (figs. 247-250).

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Lateral inflorescences in axils of upper leaves. Primary bracts green, fleshy, linear to narrow-deltoid, 1.1-1.4 mm long, 0.4-0.5 mm wide, entire, margin thickened, pilose on outer (abaxial) surface. Secondary bracts green, fleshy, linear to narrow-lanceolate, 0.7-1.1 mm long, 0.2-0.3 mm wide, entire, margin thickened, glabrous (Fig. 247).

Flowers 4-merous, closely appressed to axis, on pedicel 0.1 mm long (Fig. 248). Sepals 4, green, deltoid, (0.5-) 0.6-0.7 mm long, (0.3-) 0.4-0.6 mm wide, margins thickened, tip acute, ± saccate at base, glabrous. Petals 4, hooded, keeled, unguiculate, 0.9-1.3 mm long, 0.4 mm wide (keel to margin), scabrous on keel. Stamens 8, filaments 0.2 mm long; anthers yellow, narrow-oblong, (0.5-) 0.6-0.8 mm long, 0.2 mm wide, 4-celled, nonapiculate, antisepalous anthers ca 0.2 mm longer than antipetalous ones. Styles 4, clavate, 0.2 mm long, stigmas red-purple, fimbriate, capitate. Ovary silver-grey, turbinate, (0.6-) 0.8-0.9 mm long, (0.5-) 0.8-0.9 mm wide, 8-ribbed, 3 lateral (not oblique) calluses centred on antipetalous ribs, glabrous; incompletely 4-locular, 1 ovule per locule.

Fruit silver-grey, cylindrical to obovoid, (0.7-) 1.0 mm long, (0.6-) 0.9 mm wide, 8-ribbed longitudinally, 3 (-4) lateral calluses centred on antipetalous ribs, antisepalous ribs with ca 6 minute tubercles, glabrous; sepals persistent, green, erect, enclosing styles, deltoid to cordate, 0.6-0.7 mm long, 0.5 mm wide, glabrous; 1 seed (Figs. 249, 250).

Distribution: *G. implexus* is so far only known from Kalumburu Mission and Packhorse Range (Kimberleys) in northern Western Australia, and Deaf Adder Creek Basin in Arnhem Land (Fig. 246).

Ecology: The only available collectors' notes are "sandy moist creek under escarpment; in dense mats along ground" (*Schodde AE98*), and "banks of small creekline in grass, etc." (*Symon 7113*). Flowering and fruiting occurs in May and June.

Specimens examined:

WESTERN AUSTRALIA: Fitzgerald 1003, -.v.1905, Packhorse Range, PERTH (fl., fr.); *Symon 7113,* 30.v.1971, Longini Landing, Kalumburu Mission, AD (fl., fr.) — type of *G. implexus. NORTHERN TERRITORY: Schodde AE98,* 11.vi.1972, Deaf Adder Creek Basin, NT (fl., fr.).

The specific epithet refers to the matted habit which seems characteristic of this plant.

The collection *Schodde AE98* has proportionally narrower leaves (ovate instead of orbicular) than the other two collections, and its flowers and fruits are smaller in all their dimensions. However, its general habit, leaf texture, indumentum and inflorescence structure place it firmly in this species.

G. implexus is most closely allied to *G. chinensis*, having identical hairs, bracts and bracteoles and sharing a similar habit and habitat. However, the two species are easily distinguished by the differences in sculpturing of the fruit, shape, size and texture of the leaves, and the basal callus of the sepals present in *G. chinensis* but absent in *G. implexus*.

14. **Gonocarpus chinensis** (Lour.) Orchard (Figs. 251-259)

Gonocarpus chinensis (Lour.) Orchard, comb. nov.

Gaura chinensis Loureiro, Fl. Coch. (1790) 225 [Typus: "Habitat inculta Cantone Sinarum" n.v.]

Haloragis chinensis (Lour.) Merrill. Trans. Am. Phil. Soc. n.s. 24, 2 (1935) 290, 39; Tuyama, J. Jap. Bot. 14 (1940) 284; Merrill. Sunyatsenia 5 (1940) 150 n.v.; Merrill & Perry, J. Arn. Arb. 23 (1942) 401; Merrill & Perry, J. Arn. Arb. 29 (1948) 161; Sinclair, Gard. Bull. Sing. 15 (1956) 24; Tardieu-Blot, Fl. Laos, Camb. & Vietn. 4 (1965) 120, 122; Keng, Malay. Nat. J. 23 (1970) 123-4; Praglowski, Grana 10 (1970) 170; v.d. Meijden & Caspers, Fl. Males. 7 (1971) 243-244.

Haloragis chinensis var. *yapensis* Tuyama, J. Jap. Bot. 16 (1940) 284-5 [Typus: "Micronesia, Caroline, Yap; Ins. Tomil (leg. T. Tuyama, Sept. 22, 1939 — typus in Herb. Univ. Imp. Tokyo)". Holotypus: n.v.]

Goniocarpus scaber Koenig, Ann. Bot. 1 (1805) 547 [Typus: "Habitat in Chinae Insula prope Macao intra culta. David Nelson 1780" n.v.] Juss., Ann. Bot. 1 (1805) 541; Drake (?) in Rees, Cyclop. 16 (1811); DC., Prod. 3 (1828) 66; Britten, J. Bot. 45 (1907) 135.

Haloragis scabra (Koenig) Benth., Fl. Hongk. (1861) 139 (excl. spec. Khasyan.); Schindler, Bot. Jb. 34 Beibl. 77 (1904) 30; Schindler, Pflrch 23 (1905) 28-29; Britten, J. Bot. 45 (1907) 135; Went, Nova Guinea 14 (1924) 107; Mansfeld, Bot. Jb. 61 (1927) 26; v. Steenis, Bull Jard. Bot. Buitenz. Ser. 3, 13 (1934) 218; Praglowski, Grana 10 (1970) 168.

Haloragis scabra var. *elongata* Schindler, Pflrch 23 (1905) 29 [Typus: "China: bei Hongkong, Kanton, Insel Chu-san (Faber, Hance herb. n. 530, Hillebrand, Hooker n. 857, Schottmüller n. 376); Tong-king, bei Hong-ay (Balansa n. 1529). — Herb. Berlin, Boiss-Barbey, Delessert, Petersb., Wien." Lectotypus (Orchard): *Hillebrand 1889*, 11.vii.1869, Canton, G (Herb. Delessert) (fl., fr.)! Isolectotypi: G (Herb. Delessert — second sheet)!, G! Syntypi: *Balansa 1529*, 17.xii.1885, Tonkin, environs du poste militaire de la Baie de Hong-ay, G (Herb. Boissier, DC.) (fl., fr.), LE!; *Yvan s.n.*, 1846, Ile de Chusan, G (Herb. Delessert) (fl.)!] Merrill, Philip. J. Sci. 1 (1906) Suppl. 216; Britten, J. Bot. 45 (1907) 135; Guillaumin, Bull. Bot. Soc. France 61 (1914) 9; Merrill, J. Str. Br. R. As. Soc. 76 (1917) 102; Guillaumin, Fl. Gen.I.-C. 2 (1920) 715; Merrill, Enum. Philip. Pl. 3 (1923) 221; Kanehira, J. Dept. Agr. Kyushu Univ. 4 (1935) 383; Lam, Blumea 5 (1945) 581.

Haloragis scabra var. *novaguineensis* Valeton, Bull. Dep. Agr. Ind. Neerl. 10 (1907) 41-2 [Typus: "Nord N. Guinea (G. Pisero)". Holotypus: n.v.] Went, Nova Guinea 14 (1924) 108; Mansfeld, Bot. Jb. 61 (1927) 26; Merr. & Perry, J. Arn. Arb. 29 (1948) 161.

Haloragis tetragyna var. *micrantha* Benth., Fl. Aust. 2 (1864) 484 p.p. [Typus: based on *Gonocarpus scaber* Koenig] Bailey, Qld. Fl. 2 (1900) 556 p.p.; Bailey, Comp. Cat. Qld. Pl. (1913) 174 p.p.

Haloragis tetragyna auct. non (Labill.) Hook. f.: Clarke, Fl. Brit. India 2 (1878) 430-1; Forbes & Hemsley, J. Linn. Soc. Bot. 23 (1887) 292; Petersen, Pflfam. 3 (1893) 230; Volkens, Bot. Jb. 31 (1902) 471.

Figs.: Jussieu, Ann. Bot. 1 (1805) pl. 12, fig. VI; Schindler, Pflrch 23 (1905) fig. 9A; Guillaumin, Fl. Gen. I.-C. 2 (1920) fig. 74-14; Tuyama, J. Jap. Bot. 14 (1940) 284, fig. 5 (b), 6.

Erect or ascending perennial herb 20-45 cm tall; rootstock a simple taproot; stems weak, herbaceous, branching mainly from base, sometimes rooting at lower nodes, reddish, green or silver-grey, strongly 4-ribbed, glabrous in older parts, younger parts scabrous with sparse, appressed, 1-2-celled simple hyaline hairs 0.2-0.3 mm long, confined mainly to ribs.

Leaves decussate, often becoming alternate near inflorescence, very shortly petiolate or subsessile, linear to linear-lanceolate, 1.0-2.8 cm long, 0.2-0.6 (-0.8) cm wide, rounded at base, gradually tapering to apex, margin thickened, ± revolute, serrate with 15-30 obliquely cuspidate teeth up to 0.5 mm long, midrib indistinct or sunken above, prominent below, lateral veins obscure, scabrous on both faces with sparse appressed hairs as for stem.

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Lateral inflorescences arise in the axils of the upper leaves, and may themselves bear branches. Primary bracts leaflike, lanceolate to narrow-ovate, 0.8-1.5 mm long, 0.4-0.6 mm wide, margins thickened, entire, ± glabrous. Secondary bracts brown, membranous, linear, 0.2-0.5 mm long, 0.05-0.15 mm wide (Fig. 252).

Flowers 4-merous, on pedicels 0.2 mm long (Fig. 253). Sepals 4, green, linear-deltoid, 0.6-0.8 mm long, 0.4-0.5 mm wide, margin thickened, small median basal callus, glabrous. Petals 4, yellow to red, hooded, very shortly unguiculate, 1.0-1.5 mm long, 0.3-0.5 mm wide (keel to margin), sparsely scabrous

on keel. Stamens 8, filaments 0.1-0.2 mm long; anthers yellow, linear-oblong, 0.7-1.1 mm long, 0.2 mm wide (antipetalous anthers ca 0.1-0.2 mm shorter than antisepalous ones), 4-locular, nonapiculate. Styles 4, clavate, 0.1-0.2 mm long, stigmas red, fimbriate, capitate. Ovary red-grey to dark grey, globular, 0.6-0.8 mm long, 0.6-0.8 mm wide, 8-ribbed, smooth between ribs, or with 1-2 oblique calluses, densely papillose, or with short curved papillose hairs confined to ribs; septa incomplete, 4-locules, 1 ovule per locule.

Fruit on pedicel 0.1-0.5 mm long, silver grey to dark grey, globular, 0.7-1.0 mm long, 0.7-0.9 mm wide, 8-ribbed, smooth between ribs, or with 1-2 oblique calluses, densely papillose, or with short curved papillose hairs confined to ribs; sepals persistent, erect, enclosing styles, deltoid to narrow-deltoid, 0.5-0.7 mm long, 0.3-0.4 (-0.6) mm wide, margins thickened, small median basal callus; pericarp membranous, 1 seed.

Key to subspecies of *G. chinensis*

Fruit with short curved appressed hairs confined almost entirely to the ribs; often with 1-2 oblique calluses between ribs, or if not, then fruit ± weakly 4-angled opposite petals. subsp. *chinensis*

Fruit with glistening papillae on and between ribs; never with calluses between ribs, always globular. subsp. *verrucosus*

subsp. **chinensis**

Fruit globular to weakly 4-angled opposite petals, 8-ribbed, usually with 1-2 weak oblique calluses between ribs, scabrous with short curved appressed hairs confined almost entirely to ribs (Figs. 254-256).

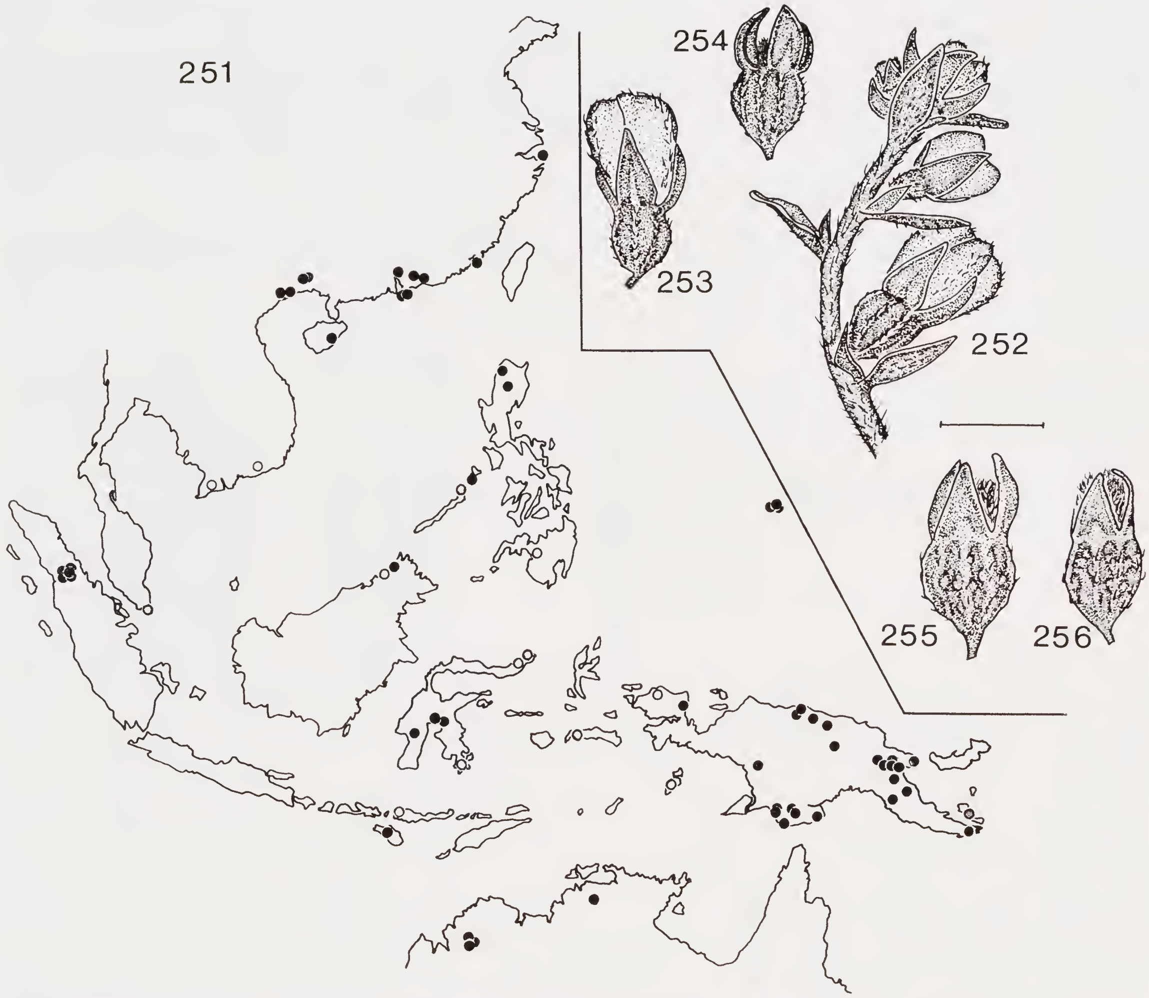
Distribution: This subspecies is widespread from southern China to north-western Australia, and is an introduced weed in Hawaii. It has been recorded from China, Hong Kong, North and South Vietnam, Singapore, Sumatra, Philippines, Sabah, Celebes, Sumba, West Irian, Papua New Guinea, Caroline Islands, Northern Territory and Western Australia (Fig. 251).

Ecology: *G. chinensis* subsp. *chinensis* is found in open grassland or savannah woodland from sea level to about 2200 m. Collectors' notes include "in the lalang" (*Hamel & Toroes 704*); "an occasional patch in tall grassland on hillside" (*Hoogland & Pullen 5315*); "grassland on steep sandy, clayey soil" (*Koster BW8012*); "monsoon scrub on poorly drained plain" (*Paijmans 277*); "roadside weed" (*Robbins 462*); "in grass, sedges, etc., edge of *Pandanus* swamp" (*Sayers NGF18905*); "fairly common, growing in thickets on dry clayey soil" (*Tsang 29502*); "erect herb on side of track in sunny situations" (*Womersley 5108*); "semiprostrate herb in grassland" (*Womersley and Henty NGF11679*); "on red clay soil, in open field; the plant is used in the medicine for open cuts (fely mathatheth), the entire plant is pounded and squeezed with the sap dripping on the cut." (*Wong 538*). Flowering and fruiting occur throughout the year, with a peak from about May to September.

Native name: Ruruthy (Yap: *Wong 538*).

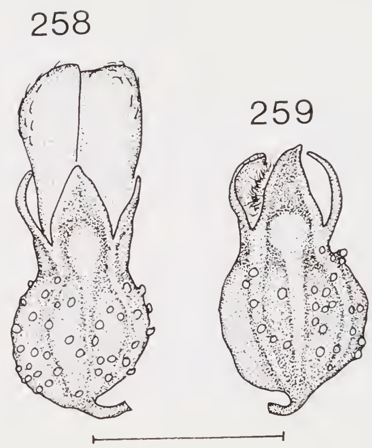
Specimens examined:

CHINA: Ah To s.n., 18.v.1917, Honam Island, Kwangtung Prov., PNH88284 (fl.); *Ah To s.n.,* 23.v.1917, Honam Island, Kwangtung Prov., PNH88283 p.p. (fr.); *Chung 5245,* 12.x.1926, Nanputo, Amoy, Fukien Prov., A (fl., fr.); *Hillebrand 1889,* 11.vii.1869, Canton, G (3 sheets) (fl., fr.) — types of *H. scabra* var. *elongata*; *How 73866,* 18.x.1935, Wanning, Hainan, GH (fl., fr.); *Liang 69600, 69787,* 12.vii.1937, Nar Pui Sup Man Ta Shan [? Shih wan-ta Shan] Kwangsi Prov., A (fl., fr.); *Tsang 25758,* 12-30.ix.1935, Lin Fa Shan, Sam Hang Shek T'au village, Hwei-yang district, Kwangtung Prov., A (fl., fr.); *Tsang 25972,* 1-19.x.1935, Sam Hang Shek T'au village, Kwangtung Prov., A (fl., fr.); *Tsang & Wong 2816,* 23.x.1926, Wan Tong Shan, Tai Tsan, Ying Tak, Kwangtung Prov., A (fl., fr.); *Yvan s.n.,* 1846, Ile de Chusan (Tcheou), Chekiang Prov., G (herb. Deless.) (fl.) — syntype of *H. scabra* var. *elongata*. *HONG KONG: Champion s.n.,* Hong Kong, CGE (fl., fr.); *Bentham s.n.,* Hong Kong, CGE (fl., fr.); *Lohuy s.n.,* -.v.1897, Hong Kong (Peak), M (fr.); *Tang 1395,* 15.ix.1952, Shaukiwan, A (fl.); *Wilford s.n.,* Hong Kong, GH (fl., fr.); *Wright s.n.,* 1853-1856, Hong Kong, GH (fl., fr.). *MACAU:* Reported by van der Meijden & Caspers (1971) but I have seen no specimens. *NORTH VIETNAM: Balansa 1529,* 17.xii.1885, environs du poste militaire de la Baie de Hong-ay, G (herb. DC., Boiss.), LE (fl., fr.) — syntype of *H. scabra* var. *elongata*; *Tsang 29502,* 1-10.ix.1939, Tong Fa market, Taai Wong Mo Shan and vicinity, Ha-cei, A (fl., fr.). *SOUTH VIETNAM:* Reported by Guillaumin (1914) ['Cochinchine'], but I have seen no specimens. *SINGAPORE:* Reported by Keng (1970) but I have seen no specimens. *SUMATRA: Bartlett 8340,* 11.vi. 1927, Hoeta Gindiang (north-west of Balige), Toba, NY (fl., fr.); *Boeea 6067,* 4-11.xi.1933, Toetsepan, subdiv. Toba, A (fl., fr.); *Hamel & Toroes 704,* 19.vi.1928, Deleng, Piso-piso Karoland, NY (fl.); *Lörzing 6463,* 11.v.1919, Sumatra, U (fl., fr.). *PHILIPPINES: Merrill 459,* 13.ii.1902, Island of Culion, GH, NY (fl., fr.); *Merrill 4444,* -.xi.1905, Luyoc to Cervantes, Dist. Lepanto, Luzon, P (fl.); *Vanoverbergh 948,* -.viii.1913, Bontoc subprov., Luzon, P (fl.). *SABAH: Clemens 9626,* 14.xii. 1915, Jesselton, PNH (fl.); *LeRoy Topping 1454,* 23.x.1915, Jesselton, PNH (fr.). *CELEBES: Eyma 396,* 14.vi.1937, between Pasoei-Rante Lemo, Enrekang subdiv., U (fl.); *Eyma 1465,* 1.viii.1937, NE of Singkalong, Masamba subdiv., U (fl.); *Eyma 3356,* 8.xi.1938, Malili, between Pangempang-S. hintoemoeboere, A (fl.); *Eyma 3356,* 11.viii.1938, between Pangempang-S. hintoemoeboere, subdiv. Malili, U (fl.). *SUMBA: de Voogd 2534,* 30.v.1936, Prailangnia, West Soemba, BISH, GH, NY (fl., fr.). *WEST IRIAN: Brass 11629,* -.xii.1938, Balim River, BRI (fl., fr.); *Gjellerup 672,* 15.ix.1911, pr. Hollandia, U (fr.); *Kanehira & Hatasima 13206,* 27.iii.1940, Waren, 60 miles [96 km] south



Figs. 251-256. *Gonocarpus chinensis* subsp. *chinensis*. 251. Distribution (● = specimens examined, ○ = other records after Caspers & van der Meijden (1971)). 252. Tip of inflorescence. 253. Flower. 254-256. Fruits. (figs. 252-254 from *Heyligers 1559*, fig. 255 from *Robbins 462*, fig. 256 from *Hartley 12160*). Scale represents 1 mm (figs. 252-256).

of Manokwari, A (fl., fr.); *Koster BW8012*, 8.xi.1958, Kebar Valley, CANB (fl., fr.); *van Royen 4883*, 7.ix.1954, c 15 km NE of Koembe village on north bank of Koembe River, CANB (fl., fr.); *van Royen & Sleumer 5666*, 2.vi.1961, Cycloop Mountains, Ifar, A, CANB (fl., fr.). *PAPUA NEW GUINEA: Brass 5855*, -.i-iii.1934, Wuroi, Oriomo River, A, BRI, NY (fl., fr.); *Brass 22546*, 26.v.1953, Mt Dayman, Maneau Range, A, CANB (fl., fr.); *Brass 27238*, 19.vi.1956, Agamoia, Fergusson Isl., A, CANB, PNH (fl.); *Clemens 40*, 28.viii.1935, Sattelberg, Malalo Mission, Salamana, A (fl., fr.); *Clemens 10951*, 10.i.1940, Wantot, A (fr. — terat.); *Hartley 12160*, 12.viii.1963, base of Kratke Range about 12 miles [20 km] S. of Aiywa, BRI, CANB (fl., fr.); *Hartley 12256*, 3.x.1963, Markham Point-bluff bordering the Markham River about 7 miles [11 km] W. of Lae, A, BRI, CANB (fl., fr.); *Heyligers 1559*, 17.viii.1966, 30 km S.E. of Nuku, CANB (fl., fr.); *Hoogland & Pullen 5315*, 12.vi.1956, near Yontegi village, between Dunantina & Karmanuntina Rivers, A, BRI, CANB, PNH (fr. — terat.); *Kairo & Streiman NGF30962*, 8.xii.1967, Manki Trig, Bulolo, CANB (fr. — terat.); *Paijmans 191*, 9.viii.1967, c. 8 miles [13 km] W. of Morehead Patrol Post, Trans-Fly area, CANB (fr.); *Paijmans 253*, 15.viii.1967, between Morehead and Bensbach Rivers, CANB (fl., fr.); *Paijmans 277*, 18.viii.1967, ca 14 miles [22 km] NW of Morehead Patrol Post, CANB (fl., fr.); *Robbins 462*, 16.vii.1957, Kangel Valley near Tambil, CANB (fl., fr.); *Sayers NGF18905*, 14.iii.1964, Leitre village, Sepik district, BRI, CANB (fl., fr.); *Streiman & Kairo NGF47964*, 18.vii.1970, Tiaura, Saru R. track, 5 miles [8 km] SE of Garaina, CANB (st.); *Womersley 5108*, -.ii.1953, Arona Valley, A, BRI (fl., fr.); *Womersley & Henty NGF11679*, 4.ii.1960, Markham Point near Lae, BRI, CANB (fl., fr.). *CAROLINE ISLANDS: Hosokawa 8813*, 23.vii.1937, Mabo, Yap, BISH (fl., fr.); *Kanehira 1137*, -.viii.1930, Yap, BISH, NY (fl., fr.); *Volkens 395*, -.xi.1899 — -.vi.1900, Bergriesen, Yap, P (fl., fr.); *Wong 538*, 26.ii.1948, Maki, Gagil, Yap, A, BISH (fl., f-.). *HAWAII: Degener & Degener 30591*, 7.v.1966, at end of road south-south-east of 27 mile mile-post from Hilo, naturalised, A, M (fl., fr.). *WESTERN AUSTRALIA: Fitzgerald 870*, -.v.1905, base of Bold Bluff, PERTH (fl., fr.); *Fitzgerald 907*, -.v.1905, Isdell River near Grace Knob, PERTH (st.); *Fitzgerald 994*, -.v.1905, Packhorse Range, PERTH (fr.). *NORTHERN TERRITORY: Holtze 1107*, near the Adelaide R., MEL (fl., fr.); *Robinson s.n.*, 27.ix.1972, Port Keats, NT37502 (fl., fr.).



Figs. 257-259. *Gonocarpus chinensis* subsp. *verrucosus*. 257. Distribution. 258. Flower. 259. Fruit. (figs. 258, 259 from *McKee 9302*). Scale represents 1 mm (figs. 258, 259).

This variable subspecies has in the past been confused with *G. tetragynus* and *G. philippinensis*. While undoubtedly closely related to both of these species, and perhaps forming a link between them, *G. chinensis* subsp. *chinensis* is easily distinguished. Its primary and secondary bracts with very strongly thickened margins separate it from *G. tetragynus*, and its 8-, rather than 4-stamened flowers separate it from *G. philippinensis*. From both species it is distinct in its slender habit and proportionately narrower leaves.

G. chinensis subsp. *chinensis* is distinguished from subsp. *verrucosus* only on the characters of the fruit. The former has a slightly larger fruit, tending to be slightly angular as well as ribbed, with usually 1-2 oblique calluses between the ribs, and short curved hairs confined mainly to the ribs. The latter subspecies tends to have, on average, slightly smaller fruits, always globular, lacking oblique calluses, and bearing glistening papillae on and between the ribs. Rarely the papillae have a very short thick curved hair seated upon them. Subspecies *verrucosus* is confined to Queensland and New South Wales, although some of the lowland collections from Papua New Guinea here included under subsp. *chinensis* are to a slight degree intermediate between the subspecies.

The Hillebrand collection was chosen as lectotype of *H. scabra* var. *elongata* because it was the most complete of the three alternatives. The Yvan collection lacks fruits, and the Balansa collections are nearly all devoid of leaves.

subsp. **verrucosus** (Maid. & Betche) Orchard, comb. et stat. nov.

Haloragis verrucosa Maid. & Betche, Proc. Linn. Soc. N.S. Wales 31 (1906) 397 [Typus: "Woodburn, Richmond River; W. Baeuerlen; December, 1894". Holotypus: *W. Baeuerlen s.n.*, -.xii.1894, Woodburn, NSW113168 (fl., fr.)! Isotypus: *W. Baeuerlen s.n.*, -.xii.1894, Woodburn, Richmond River, MEL1003647 ex NSW (fl., fr.)!] Maid. & Betche, Census N.S. Wales Pl. (1916) 158; Blake, Proc. R. Soc. Qld. 73 (1963) 64-5; Beadle, Evans & Carolin, Fl. Syd. Reg. (1972) 207.

Haloragis tetragyna var. *micrantha* Benth., Fl. Aust. 2 (1864) 484 p.p.; Bailey, Qld. Fl. 2 (1900) 556 p.p.

Fruit globular, 8-ribbed, lacking oblique calluses between ribs, ± densely covered with glistening papillae on and between the ribs; the papillae rarely bearing a very short, thick curved hair at apex (Figs. 258, 259).

Distribution: *G. chinensis* subsp. *verrucosus* is found only in the coastal regions of northern New South Wales and Queensland, from near Sydney to Atherton (Fig. 257).

Ecology: This subspecies seems to prefer open, wet or swampy habitats, from sea level to about 750 m. Collectors' notes include "in swampy places" (*Blake 3133*); "sandy loam in *Casuarina* country" (*Dovey XA13*); "on heavy grey clay loam subject to waterlogging" (*Henderson H158*); "on moist black sand on dune above sea; associated species: *Pultenaea myrtoides, Pomax umbellata, Goodenia stelligera*" (*McGillivray 2098*); "growing amongst a sclerophyllous heath in a black sandy swamp behind sand dunes" (*Orchard 2385*); "in whitish clay in peaty swamp" (*Orchard 2387*). Flowering and fruiting occurs from September until May.

Specimens examined:

QUEENSLAND: Bailey s.n., 1.iii.1891, Yandina, BRI080138 (fl., fr.); *Blake 3133*, 18.xii.1931, Lawnton, 17 miles [27 km] N. of Brisbane, BRI (fl., fr.); *Blake 4240*, 25.viii.1932, Caloundra, BRI (st.); *Blake 15495*, 31.iii.1945, Samford, BRI (fl., fr.); *Blake 21159*, 17.xi.1959, near Sunnybank, BRI (fl., fr.); *Clemens s.n.*, -.iv.1945, Coolum, BRI015161 (fl., fr.); *Clemens s.n.*, 1-3.x.1946, Double Island Point, BRI019034, 080141 (fl., fr.); *Clemens s.n.*, -.vii-xi.1947, Dalrymple Heights and vicinity, BRI080146 (fl., fr.); *Clemens s.n.*, 5.xi.1948, Maryborough, BRI080142 (fl., fr.); *Colonial Botanist s.n.*, Nerang, AD96905138 (fl., fr.); *Dovey XA13*, -.x.1930, Rosedale, BRI (fl.); *Dovey 183*, 18.iii.1933, Rosedale, BRI (fl., fr.); *Henderson H158*, 11.xii.1966, Salisbury, Brisbane, BRI (fl., fr.); *McKee 9302*, 23.iv.1962, 1 mile [2 km] south of Atherton, CANB, NSW (fl., fr.); *Meebold 3603*, -.v.1929, Brisbane, M (fl.); *Michael 799, 1129*, Kelsey Creek near Proserpine, BRI (fl., fr.); *O'Brien s.n.*, 1909, Sunnybank near Brisbane, BRI080149 (fl., fr.); *Pedley 2185*, 22.xii.1966, Hollywell near Southport, BRI (fl., fr.); *Ridley s.n.*, 13.iv.1959, about 5 miles [8 km] NW of Tiaro, BRI024463 (fl., fr.); *Smith & McGillivray 3071*, 16.v.1968, 1 mile [2 km] north of Beerwah, NSW (fl., fr.); *Stuart 100*, Moreton Bay, MEL (fl.); *White s.n.*, -.iv.1915, Bribie Island, BRI080140 (fl., fr.); *White s.n.*, 17.iii.1916, Wellington Point, BRI080147 (fl., fr.); *White s.n.*, -.xi.1916, Darra, BRI080143 (fl.); *White s.n.*, -.v.1917, Candle Mountain, BRI080178 (fl., fr.); *White s.n.*, -.iv.1918, Kedron Brook near Brisbane, BRI080148, NSW99121 (fl., fr.). *NEW SOUTH WALES: Baeuerlen s.n.*, -.xii.1894, Woodburn, MEL1003647, NSW113168 (fl., fr.) — type of *H. verrucosa*; *Bauer s.n.*, Nov. Holland., W (st.) — syntype of *H. veronicifolia*; *Blakely s.n.*, -.iv.1919, Hawkesbury River, AD96921181 (fr. — terat.); *Fawcett s.n.*, Richmond River, MEL39412 (fr.); *McGillivray 2098*, 30.vi.1966, 4 miles [6.5 km] directly south of Yamba, NSW (fr.); *Orchard 2385*, 28.x.1969, ca 5 km south of Yamba, AD (fl., fr.); *Orchard 2387*, 28.x.1969, ca 6 km south of Coffs Harbour, AD (fl., fr.).

This plant has in the past been confused with *G. tetragynus* and *G. longifolius*. From both of these species it can be distinguished by its weak herbaceous habit and papillose fruits lacking oblique calluses between the ribs.

As in several other species of *Gonocarpus*, occasional specimens are known in which the flowers are functionally female, with abortive petals and stamens (e.g. *Colonial Botanist s.n.*, AD96905138).

The Bauer collection cited above was misidentified by Schindler as *Haloragis veronicifolia*, and is an excluded syntype of that species.

15. **Gonocarpus philippinensis** (Merr.) Orchard (Fig. 260)

Gonocarpus philippinensis (Merr.) Orchard, comb. nov.

Haloragis philippinensis Merrill, Philip. J. Sci. 1, Suppl. (1906) 216-217 [Typus: "Luzon, Province of Benguet, Baguio to Ambuklao (4357 *Merrill*) October 24, 1905; District of Lepanto, Suyoc to Cervantes (4444 *Merrill*) October 30, 1905; Mount Data (4553 *Merrill*) November 4, 1904. On dry, open, grassy slopes in thin pine forests, 1,500 to 2,100 m." Lectotypus (Caspers & v.d. Meijden): *Merrill 4357*, October-November 1905, Luzon, Province of Benguet. Baguio to Ambuklao, US710220 (fr.)! Isolectotypus: NY (fr.)! Syntypus: *Merrill 4553*, -.xi. 1905, Mt. Data, District of Lepanto, Luzon, P (fl., fr.!] Merrill, En. Philipp. Pl. 3 (1923) 221; van Steenis, Bull. Jard. Bot. Buitenz. Ser. 3, 13 (1934) 217; Praglowski, Grana 10 (1970) 170; v.d. Meijden & Caspers, Fl. Males. 7 (1971) 242-3.

Haloragis tetragyna var. *micrantha* Benth., Fl. Aust. 2 (1864) 484 p.p. (specim. Khasyan.); Bailey, Qld. Fl. 2 (1900) 556 p.p.

Haloragis scabra var. *abbreviata* Schindler, Pflrch 23 (1905) 29 [Typus: "Hinterindien: Khasia Berge 1500-2000 m ü. M. (Clarke n. 44575D; Hooker f. et Thomson). — Herb. Berlin, Boiss.-Barbey, DeCandolle, Kopenh., Leiden, Petersb., Wein." Lectotypus (Orchard); *J. D. Hooker & T. Thomson s.n.*, Khasia, regio temp. 5-6000 feet, G (herb. DC) (fl., fr.)! Isolectotypi: BRI080093!, CGE!, G (herb. Boiss.)!, GH!, LE!, M!, NY!, U118402! (fl., fr.)] Guillaumin, Bull. Soc. Bot. France 61 (1914) 9 ['var. *attenuata* Schindler'] p.p.

Haloragis isomera Parker, Fedde Rep. 29 (1931) 104-5 [Typus: "Burma: Tenasserim, Myinmolekat 1800 m. Parker 3129 — Assam: Khasia Hills, Clarke 44575; Hook. f. et Thoms." Lectotypus (Orchard): *Parker 3129*, Burma: Tenasserim, Myinmolekat 1800 m, n.v. Syntype: *Hooker fil. & Thomson s.n.*, Khasia, BRI080093!, CGE!, G (herb. Boiss., DC)!, GH!, LE!, M!, NY!, U118402! (fl., fr.)] Hundley & Chit Ko Ko, List Trees Burma (1961) 98; Tardieu-Blot, Adansonia 5 (1965) 119; Tardieu-Blot, Fl. Laos, Camb. & Vietn. 4 (1965) 119.

Haloragis scabra non (Koenig) Benth.: Benth., Fl. Hongk. (1861) 139 p.p.

Haloragis tetragyna non (Labill.) Hook. f.: Clarke in Hook. f., Fl. Brit. Ind. 2 (1878) 430-431 p.p.; Featon, Art. Alb. N.Z. Fl. (1889) 148 p.p.

Figs: Tardieu-Blot, Fl. Laos, Camb. & Vietn. 4 (1965) 121, pl. 1, fig. 11-13; Praglowski, Grana 10 (1970) pl. 3 (k-m).

Perennial herb 10-15 (-35) cm tall, stems weakly 4-angled, moderately densely appressed pilose, with simple, white-transparent, 1-2-celled uniseriate hairs 0.3-0.5 mm long.

Leaves decussate, ± sessile (petiole 0.5 mm long), lanceolate to narrow-ovate, 0.8-1.0 (-1.8) cm long, 0.35-0.6 (-0.8) cm wide, dark green above, lighter below, rounded or gradually tapering to base, tip acute, margins thickened, serrate with 10-15 obliquely cuspidate teeth 0.5-1.0 mm long, midrib weakly prominent below, veins otherwise indistinct, lamina ± densely appressed pilose both faces.

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts (rarely, opposite towards base). Lateral inflorescences absent or arising in axils of upper 3-4 leaves. Primary bracts leaflike, lanceolate, (1.4-) 2.5-3.5 (-5.0) mm long, 0.6-2.0 mm wide (rapidly reducing in size towards apex), lower ones 2-4 serrate, upper ones entire, ± densely appressed pilose both faces. Secondary bracts membranous, linear, 0.6-1.0 mm long, 0.1-0.2 mm wide, glabrous or sparsely appressed pilose on outer face.

Flowers 4-merous, on pedicels 0.2-0.3 mm long. Sepals 4, narrow-deltoid, 0.7-0.8 mm long, 0.4-0.5 mm wide, margins thickened, median deltoid or round basal callus, glabrous or very sparsely appressed pilose. Petals 4, reddish, hooded, keeled, 1.4-1.6 mm long, 0.3-0.5 mm wide (keel to margin), scabrous on keel. Stamens 4, antisepalous, filaments 0.1-0.2 mm long; anthers yellow, linear-oblong, 1.2-1.3 mm long, 0.3 mm wide, 4-celled, nonapiculate. Styles 4, clavate, 0.1-0.2 mm long. Ovary silver-grey, ovoid, 1.0-1.2 mm long, 0.8-1.1 mm wide, prominently 4-ribbed opposite petals, very weakly 4-ribbed opposite sepals, sometimes with 1-2 weak oblique calluses between ribs, sparsely appressed pilose on ribs, incompletely 4-locular, 1 ovule per locule.

Fruit ± sessile, silver-grey, ovoid, 1.3-1.5 mm long, 0.9-1.2 mm wide, 4-ribbed between sepals, ± very weakly ribbed opposite sepals, sparsely and minutely scabrous on ribs; sepals persistent, erect, ± enclosing styles, deltoid, 0.5-0.7 mm long, 0.4-0.6 mm wide, margin thickened, median basal callus, glabrous or very sparsely scabrous; pericarp membranous, 1 seed.

Distribution: This species is widespread in Malesia and south-eastern Asia, being known from the Philippines (Luzon), northern Sumatra, China (Hainan, Yunnan) and Assam (Khasi Hills). It is also recorded from Burma (Parker, 1931; Hundley & Chit Ko Ko, 1961), Thailand (Caspers & v.d. Meijden, 1971) and South Vietnam (Caspers & v.d. Meijden, 1971) but I have not seen specimens (Fig. 260).

Ecology: *G. philippinensis* is found in a wide range of habitats at altitudes of 1500-3000 m. Collectors' notes include "in the lalang" (*Hamel & Toroes 704*); "in dense woods (*Lau 27318*); "top plateau; burned vegetation" (*v. Steenis 9083*); "on open slope" (*Tsai 62701*). Flowering occurs from June until November, and fruiting from June until February.

Native name: Mergui (Burma: Hundley & Chit Ko Ko 1961).

Specimens examined:

PHILIPPINES: Clemens 9136, -.i.1915, Pauai, Benguet subprovince, Luzon, A, BISH (fr.); *Merrill 4357*, -.x-xi.1905, Baguio to Ambuklao, Benguet subprovince, Luzon, US, NY (fl., fr.) — lectotype of *H. philippinensis; Merrill 4553*, -.xi.1905, Mount Data, district of Lepanto, Luzon — syntype of *H. philippinensis. SUMATRA: Hamel & Toroes 704*, 19.vi.1928, Deling, Piso Piso, Karoland, GH (fl., fr.); *v. Steenis 9083*, 21-22.ii.1937, Mt. Goh Lembuh, Gajo & Alas Lands, A, CANB, PNH (fr.). *ASSAM: Hooker & Thompson s.n.*, Khasia mountains, BRI080093, CGE, G (herb. Boiss., DC.), GH, LE, M, NY, U118402 (fl., fr.) — types of *H. scabra* var. *abbreviata* and *H. isomera. CHINA: Lau 27318*, 28.vi.1936, Loktung, Hainan, A (fl., fr.); *Lau 28088*, 24.x.1936, Bo-ting, Hainan, A (fl., fr.); *Tsai 62701*, 16.vii.1938, Ping-pien Hsien, Yunnan, A (fl., fr.).

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Fig. 260. Distribution of *Gonocarpus philippinensis* (● = specimens examined, ○ = other records from literature).

The collections of this species from the Khasia Mountains were confused with *H. scabra* by Bentham (1861, 1864) and Clarke (1878) and were consequently placed in *H. tetragyna* when *H. scabra* was included in that species. *G. philippinensis* is undoubtedly closely allied to both of these species, but is clearly distinct. From *G. chinensis* ('*H. scabra*') it is distinguished by its reduced androecium, relatively shorter and broader leaves and usually more robust habit. *G. philippinensis* is an alpine plant and is usually found at much higher altitudes than *G. chinensis*. It differs from *G. tetragynus* mainly in its reduced androecium and characteristically thickened margins on the primary and secondary bracts. In this latter feature, *G. philippinensis* most closely resembles *G. chinensis*.

16. **Gonocarpus incanus** (A. Cunn.) Orchard (Figs. 261-265)

Gonocarpus incanus (A. Cunn.) Orchard, comb. nov.

Cercodia incana A. Cunningham, Ann. Nat. Hist. 3 (1839) 30 [Typus: "New Zealand (Northern Island). Dry exposed rocky hills. Wangaroa. — 1826, A. Cunningham." Holotypus: *A. Cunningham 44*, 1824, New Zealand, Wangaroa, K (fr.)! Isotypi (?): *Cunningham 63*, New Zealand, CGE!, U118390B! (fr.)] Raoul, Choix Pl. N.Z. (1846) 48.

Haloragis incana (A. Cunn.) Walp., Rep. 2 (1843) 99; Cheeseman, Trans. N.Z. Inst. 42 (1909) 202, 203; Cheeseman, Man. N.Z. Fl. 2 ed. (1925) 621; Cambie et al., N.Z. J. Sci. 4 (1961) 616; Moore in Allan, Fl. N.Z. (1961) 245.

Haloragis tetragyna var. *incana* (A. Cunn.) Kirk, Stud. Fl. (1899) 148.

Haloragis aggregata var. *incana* (A. Cunn.) Schindler, Pflrch 23 (1905) 35.

Gonocarpus tetragynus non Labill.: Cunn., Ann. Nat. Hist. 3 (1839) 30; Raoul, Choix Pl. N.Z. (1846) 48.

Haloragis tetragyna non (Labill.) Hook. f.: Hook. f., Fl. N.Z. 1 (1852) 62; Hook. f., Hdbk. N.Z Fl. (1864) 65; Cheeseman, Man. N.Z. Fl. (1906) 149.

Fig.: Allan, Fl. N.Z. 1 (1961) fig. 11.

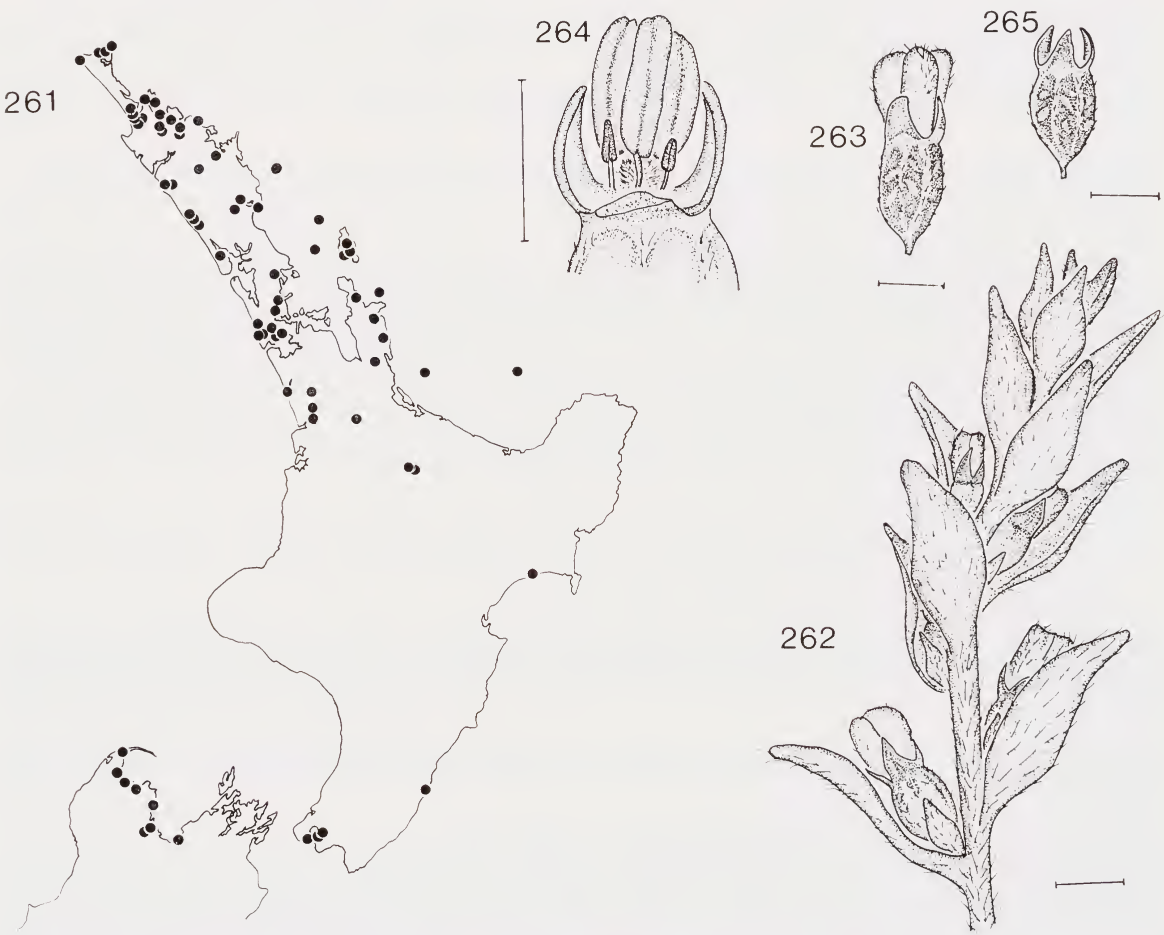
Perennial herb 15-30 cm tall, stems erect or ascending, younger ones unribbed, older ones 4-ribbed, green to red-brown, occasionally rooting at the lower nodes, ± densely appressed pilose with white uniseriate 1-2-celled simple hairs 0.2-0.4 mm long.

Leaves decussate, becoming alternate near inflorescence, ± sessile on petiole up to 1 mm long, lamina narrow-ovate to lanceolate, 4-8 (-12) mm long, 2-5 (-8) mm wide, tip acute, base rounded, margin thickened, serrate with 4-6 (-8) teeth 0.2 mm long, midrib sunken above, prominent below, lateral veins obscure, appressed pilose on both faces with hairs as for stems.

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Lateral inflorescences (usually few) arise in axils of upper leaves. Primary bracts green, leaf-like, broad-lanceolate to ovate, 2.5-4.0 mm long, (0.9-) 1.5-2.0 mm wide, entire, or 1-2-toothed in upper part, margin thickened, appressed pilose on outer face. Secondary bracts brown, ± membranous, narrow-lanceolate, 1.0-1.5 mm long, 0.2-0.5 mm wide, entire, pilose on outer face (Fig. 262).

Flowers 4-merous, on pedicels 0.2-0.3 mm long (Fig. 263). Sepals 4, green, deltoid, 0.6-0.7 mm long, 0.5-0.6 mm wide, margin thickened, weak median basal callus, glabrous. Petals 4, red, hooded, keeled, non-unguiculate, (0.8-) 1.1-1.2 (-1.6) mm long, 0.3 mm wide (keel to margin), scabrous on keel with hairs as for stems. Stamens 4, antisepalous, filaments 0.1 mm long; anthers yellow, oblong, 0.5-0.7 mm long, 0.2 mm wide, 4-celled, nonapiculate. Staminodes (1-) 4, antipetalous, filaments 0.1 mm long; anthers 0.1 mm long (rarely almost as long as in stamens), indehiscent (Fig. 264). Styles 4, clavate, 0.2 mm long; stigmas red, fimbriate, capitate. Ovary reddish to silver-grey, ovoid, 1.0-1.5 mm long, 0.9-1.0 mm wide, 8-ribbed, 2-3 weak oblique calluses between ribs, sparsely scabrous on ribs, septa incomplete 4 locules, 1 ovule per locule.

Fruit on pedicel 0.2-0.3 mm long, silver-grey, ovoid, 1.2-1.7 mm long, 1.0-1.2 mm wide, 8-ribbed, 2-3 oblique calluses between ribs, scabrous on ribs; sepals persistent, erect, deltoid, 0.6-0.7 mm long, 0.5-0.6 mm wide, margin thickened, median basal ± deltoid callus; 1 seed (Fig. 265).



Figs. 261-265. *Gonocarpus incanus*. 261. Distribution. 262. Upper part of inflorescence. 263. Flower. 264. Upper part of flower with petals and 1 sepal removed to show stamens and staminodes. 265. Fruit. (figs. 262-265 from *Orchard 3573*). Scales represent 1 mm (figs. 262-265).

DISTRIBUTION: This species is found throughout the lowlands of the North Island of New Zealand, from Wellington to North Cape. In the South Island it is confined to the coastal plains around Nelson and Golden Bay (Fig. 261).

ECOLOGY: *G. incanus* is a lowland species rarely found above an altitude of 150 m., usually in open situations amongst heath on poor clay soils. Collectors' notes include "common where recent burn" (*Burke WELTU8031*); "in clay soil" (*Carse CANTY728*); "in sandy peat alongside lake" (*Cooper et al. AK35769*); "in tall manuka scrub" (*Cranwell AK101099*); "pumice ash, warm soil, light scrub" (*Franklin WELTU2664*); "manuka scrub, in windswept scrub; spp. assoc. *Leptospermum ericoides, L. scoparium, Helichrysum filicaule, Lycopodium volubile*" (*Healy 553*); "on ploughed fire strip" (*Heine WELT40815*); "dry bank above lake at border of *Leptospermum* scrub" (*Melville & Moore 5322*). Flowering takes place from September until February, and fruiting from October until April.

SPECIMENS EXAMINED:

SOUTH ISLAND: Calder s.n., -.i.1959, Westhaven Inlet, CANU10288 (fr.); *Gibbs 405*, Para Para, CHR117725 (fr.); *Hay s.n.*, 1.i.1952, Puramahoe, Takaka, CHR73658 (fr.); *Healey s.n.*, 5.iii.1944, Lower Moutere Hills, CHR44761, 87093 (fl.); *Moore s.n.*, 5.i.1947, Collingwood, CHR51632 (fl., fr.); *Scott s.n.*, 20.x.1954, Takaka, CHR92805 (fl.); *Scott s.n.*, 6.xi.1954, Takaka, CHR87721, 87722 (fl.); *Scott s.n.*, 11.iv.1956, Takaka, CHR76036 (st.); *Simpson 4775*, 24.x.1965, Cape Farewell, CHR167599 (fl.); *Talbot s.n.*, 18.xi.1962, Moutere Hills, CHR157527 (fl., fr.); *Talbot s.n.*, 22.xi.1962, Sandy Bay, CHR157526 (fl., fr.). *NORTH ISLAND: Anon s.n.*, -.i.1896, Dargaville, WELT42672 p.p. (fl., fr.); *Allan s.n.*, 16.xii.1940, Coopers Beach, CHR87101 (fr.); *Allan s.n.*, 11.xii.1941, Parapara near Mangonui, CHR87705 (fr.); *Burke s.n.*, 5.xii.1963, Kerr Point, WELTU8031 (fl., fr.); *Burke & G.K.R. s.n.*, 30.viii.1964, Kerr Point, WELTU8043 (st); *Carse s.n.*, Fairburn, AK5921 (fr.); *Carse s.n.*, Maungatapere, CANTY764 (fl., fr.); *Carse s.n.*, Henderson, CANTY776, 777 (fr.); *Carse s.n.*, -.x.1897, Kaitara, Whangarei, CANTY763 (fl., fr.); *Carse s.n.*, -.i.1898, Whangarei Heads, CANTY766 (st.); *Carse s.n.*, -.i.1901, Kaitaia, WELT42662 (fr.); *Carse s.n.*, -.xii.1908, Peria, CANTY728, CHR11355 (fl., fr.); *Carse s.n.*, -.iv.1914, Kaitaia, CANTY729, 761, 769, 770 (fl., fr.); *Carse s.n.*, -.xii.1914, Waikauia, CANTY771 (fr.); *Carse s.n.*, 1.iii.1919, Peria, CANTY773 (fr.); *Carse s.n.*, -.v.1922, Henderson, CANTY792 (st.); *Carse s.n.*, -.vi.1922, Scraggy Hill, New Lynn, Auckland, CANTY775 (st.); *Carse s.n.*, -.iii.1924, Whangaroa Harbour, CANTY772 (st.); *Carse s.n.*, -.xi.1925, Motumaoho-Tauhei road, CANTY778 (fl.); *Carse s.n.*, -.ii.1928, Twilight Bay nr. Cape Maria van Diemen, CANTY765 (st.); *Carse & Matthews s.n.*, 4.x.1912, Wildcat Valley, Manganui Co., CANTY762 (st.); *Cheeseman s.n.*, Whangaroa Harbour, CANTY730 (fr.); *Cheeseman s.n.*, Auckland, G (fr.); *Cheeseman s.n.*, -.xii.1872, Manganui, AK5922, CANTY774, WELT 42667 (fr.); *Cheeseman s.n.*, -.xii.1872, vicinity of Auckland, AK5925 (fl., fr.); *Cheeseman s.n.*, -.xii.1879, vicinity of Auckland, AK5924, WELT40823 (fr.); *Cheeseman s.n.*, -.i.1896, Kapowairua, Spirits Bay, AK5920, WELT 42666, WELTU2660 (fl., fr.); *Cockayne s.n.*, Auckland, WELT42673 (fl., fr.); *Cockayne s.n.*, -.i.1896, Dargaville, WELT42672 (fl., fr.); *Collett s.n.*, -.viii.1965, Mokohinau Is., CHR183370 (st.); *Cooper s.n.*, 22.iii.1949, Kerr Point, AK24459 (st.); *Cooper s.n.*, 13.i.1950, Whatawhiwhi, AK36099 (fr.); *Cooper s.n.*, 28.xi.1964, Hot Springs, Great Barrier Is., AK119686 (fr.); *Cooper s.n.*, 13.ii.1965, Port Waikato, AK121910 (fr.); *Cooper s.n.*, 15.ii.1965, Waingaro, AK121909 (st.); *Cooper s.n.*, 24.viii.1965, Taipa cemetery, AK118419 (st.); *Cooper s.n.*, 1.xii.1965, Kennedy Bay, AK126283 (fr.); *Cooper s.n.*, 16.vii.1968, Matauri Bay road, AK128302 (st.); *Cooper s.n.*, 8.ix.1968, 1 mile [2 km] north of Kelly Bay, N. Kaipara, AK120015 (fl., fr.); *Cooper s.n.*, 13.xi.1968, Kaiiwi Lake, AK120198 (fl., fr.); *Cooper s.n.*, 30.x.1969, Kapowairua, Spirits Bay, AK121380 (fl., fr.); *Cooper, Mason & Moar s.n.*, 29.xi.1949, Awanui, AK35769 (fl.); *Cranwell s.n.*, 18.x.1936, Whangarei Heads, hills E. of Parua Bay, AK70608 (fl.); *Cranwell s.n.*, 13.ii.1937, Poor Knights Is., AK101097, 101099 (st.); *Croxall s.n.*, 24.v.1970, Mt. Manaia, AK126103 (st.); *Cunningham 44*, 1824, Whangaroa, K (fr.) — holotype of *C. incana*; *Cunningham 63*, New Zealand, CGE, U118390B — ? isotypes of *C. incana*; *Falla & Pycroft s.n.*, -.x.1933, Mokohinau Is., AK101098 (st.); *Filhol s.n.*, 1875, Whangaroa, P (st.); *Franklin s.n.*, 25.viii.1957, Rotorua, WELTU2664 (st.); *Given s.n.*, 31.viii.1926, Whangarei, CHR11321 (st.); *Hamilton s.n.*, 7.i.1956, Little Barrier Island, CHR95476 (fr.); *Harris s.n.*, 10.iv.1948, near Waihuahua, CHR70108 (st.); *Healy 553*, 20.vi.1937, Wainuiomata Valley, CHR (st.); *Heine s.n.*, 28.ix.1933, Days Bay, WELT40815 (st.); *Holloway & Carse s.n.*, 9.i.1914, Pukemiro, Kaitaia, CANTY768 (fl., fr.); *Hynes s.n.*, 11.xi.1961, Lake Waiparera, AK71273 (fl., fr.); *Hynes s.n.*, 21.xi.1964, Anawhata Ridge, AK104310 (fl., fr.); *Hynes s.n.*, 12.i1969, Mercer Bay track, AK120173 (fr.); *Hynes s.n.*, 24.i.1970, Lake Taharoa near Kaihu, AK127656 (fl., fr.); *Hynes s.n.*, 22.viii.1971, Red Mercury Island, AK128808 (st.); *Kelly s.n.*, -.xi.1966, 5 miles [8 km] S. of Whangarei, CHR177976 (fl., fr.); *Kelly s.n.*, -.iv.1967, Whareana, N. Cape, CHR178136 (fr.); *Kirk s.n.*, Auckland, AD96906010, AK11474, CANTY727, WELT42678 (fl., fr.); *Kirk s.n.*, 7.ii.1868, Te Whau, CANTY719, WELT42674 (fl., fr.); *Kirk s.n.*, -.iv.1868, Whangaroa, WELT42697, 42675, 42676 (st.); *Lush s.n.*, 16.x.1949, Little Barrier Island, WELT40814 (st.); *Mason s.n.*, -.iii.1933, Kaikohe, CHR22037 (fr.); *Mason & Moar 268*, 29.xi.1949, Lake Rotokawau, CHR (fl.); *Mason & Moar 298*, 30.xi.1949, Kair Kair Bay, CHR (fl., fr.); *Mason & Moar 6254*, 24.xi.1958, Lake Whangape, CHR (fl., fr.); *Matthews s.n.*, Kaitaia, AK5923 (st.); *Mellor s.n.*, -.i.1956, Whangarei Heads, WELT6906 (fr.); *Melville & Moore 5322*, 11.xi.1961, Lake Waiparera, CHR (fr.); *Moar s.n.*, 24.xi.1948, Swanson, CHR64335 (fl., fr.); *Moar s.n.*, 24.xi.1948, Waitakeres, CHR84112 (fl., fr.); *Molesworth s.n.*, 12.xii.1938, Mangapiko rock, Great Barrier Is., AK100960 (fl., fr.); *Moore s.n.*, -.vii.1952, Little Barrier Island, CHR78453 (st.); *Moore s.n.*, 24.xii.1953, Warkworth, CHR 83646 (fl., fr.); *Moore s.n.*, 27.xii.1953, Puketi Road, Okaihau-Kaeo, CHR83627 (fl., fr.); *Moore s.n.*, 1.i.1954, between Spirits Bay & Hooker Bay, CHR87704 (terat.); *Moore s.n.*, 10.vii.1955, Silverdale, CHR95629 (st.); *Moore s.n.*, 8.xi.1961, Pipeclay W. of Waipoua, CHR141814 (fl., fr.); *Moore s.n.*, 8.xi.1961, Beach Road, Waipoua, CHR141815 (fl., fr.); *Moore s.n.*, 22.viii.1972, Whangaparapara, Great Barrier Island, CHR232909 (st.); *Moore s.n.*, 23.viii.1972, trig track, Whangaparapara, CHR232984 (st.); *Moore & Michie s.n.*, 1.i.1954, Kerr Point, North Cape, CHR83659 (fl., fr.); *Oliver s.n.*, 24.xi.1916, North Cape Pen., WELT6901, 42702 (fl., fr.); *Oliver s.n.*, 25.xi.1916, Tom Bowling Bay, WELT42692 (fr.); *Oliver s.n.*, 26.xii.1919, Raglan, WELT6887

(fr.); *Oliver s.n.*, 9.vi.1940, Miramar, WELT6878 (st.); *Oliver s.n.*, 24.ix.1940, Castlepoint, WELT6879 (st.); *Orchard 3422*, 2.viii.1972, hills above Mercer Bay, AK (st.); *Orchard 3573*, 12.x.1972, western boundary of North Cape Reserve, AK (fl., fr.); *Parris s.n.*, 1.viii.1968, Tawhiti Rahi, Poor Knights Islands, AK128113 (st.); *Parris s.n.*, 26.x.1969, North Cape, AK128030 (fl.); *Petrie s.n.*, -.ii.1877, Rotorua, WELT40793 (fl., fr.); *Petrie s.n.*, -.xi.1894, Tirau, upper Thames Valley, WELT40799 (fl., fr.); *Petrie s.n.*, -.i.1896, Dargaville, WELT40798 (fl., fr.); *Petrie s.n.*, -.i.1896, Wairoa, WELT2663 (st.); *Petrie s.n.*, -.xi.1898, Tairua Harbour, WELT40797 (fl., fr.); *Petrie s.n.*, -.iii.1909, Dimphail, Te Akatea, AK5926, WELT42668 (fr.); *Petrie s.n.*, -.xi.1918, Chelsea, CANTY 720, WELT42665 (fl., fr.); *Petrie s.n.*, -.i.1919, Birkdale, WELT42661 (fl., fr.); *Petrie s.n.*, 20.x.1919, Chelsea, WELT42660 (fl.); *Petrie s.n.*, 16.i.1922, Dimphail Farm, Te Akatea, AK100937, CANTY722, WELT42663, 42664 (fl., fr.); *Phillips-Turner s.n.*, -.ii.-, Mayor Island, AK100932 (st.); *Raoul s.n.*, 1843, Bay of Islands, P (st.); *Silvester s.n.*, -.xii.1963, Waipoua, CANU9683 (fr.); *t'Woudt s.n.*, -.i.1948, Mercury Bay, WELTU2643 (fl., fr.); *t'Woudt s.n.*, -.ii.1948, Mercury Bay, WELTU2639 (fl., fr.); *Warren s.n.*, Lake Tahora, north of Dargaville, CHR208216 (fl., fr.); *Zotov s.n.*, 26.xi.1953, near Kaikohe, CHR84917 (fl., fr.).

Gonocarpus incanus has often been compared with *G. tetragynus* and has even been considered synonymous or conspecific with that species. While the two are obviously closely related, and are very similar in such characters as habit, leaf and fruit morphology and indumentum, they are clearly distinct in certain floral characters. The petals of *G. incanus* are only half as long as those in *G. tetragynus*, and the androecium is reduced to 4 stamens and 4 staminodes. In these characters *G. incanus* more closely resembles *G. humilis*, but differs in its appressed indumentum and more compact inflorescence.

Intermediate specimens between *G. incanus* and *G. montanus* are fairly common where the two species overlap at moderate altitudes in North Island and northern South Island New Zealand, indicating that these two species also share a close affinity. This is discussed further under *G. montanus*.

The size of the staminodes in *G. incanus* varies considerably from plant to plant. Typically they are about half the size of the stamens, although occasionally they may be vanishingly small (even reduced to 1 or 2 instead of 4) or almost as large as the stamens (e.g. *Moore & Michie CHR83659*). In all cases however, the "anthers" of the staminodes are indehiscent. On other plants, all of the stamens are abortive, and the flowers are functionally female (e.g. *Zotov CHR84917*).

17. **Gonocarpus mezianus** (Schindl.) Orchard (Figs. 266-272)

Gonocarpus mezianus (Schindl.) Orchard, comb. nov.

Haloragis meziana Schindler, Pflrch 23 (1905) 29 [Typus: "Australien: Victoria (Walter, Schomburgk); ohne Fundort (Behr n. 165, Gaudichaud (?), F. v. Mueller). — Tasmania (F. v. Mueller). — Herb. Halle, Berlin, Petersb., Wien. Lectotypus (Orchard): *Walter s.n.*, Victoria, Grampians, MEL39166 (ex B) (st.)! Isolectotypus: *C. Walter s.n.*, Grampians, NSW87862 (ex B) (st.)! Syntypi: *Mueller s.n.*, Nov. Holland. meridional., LE (st.)!; *Schomburgk s.n.*, Australia, LE (st.)!] Schindler, Bot. Jb. 34, Beibl. 77 (1904) 30, 42; Britten, J. Bot. 45 (1907) 135; Ewart, Fl. Vict. (1930) 881; Praglowski, Grana 10 (1970) 168; Willis, Hdbk. Pl. Vict. 2 (1972) 468.

Haloragis teucrioides var. *meziana* (Schindl.) J. M. Black, Fl. S. Aust. ed. 1 (1926) 430; Black, Fl. S. Aust. ed. 2 (1952) 642.

Haloragis teucrioides var. *glabrata* Sonder, Linnaea 28 (1856) 230[Typus: "Port Lincoln (Wilhelmi)". Holotypus: *Wilhelmi s.n.*, 1853, Port Lincoln, MEL39163 p.p. (st.)!].

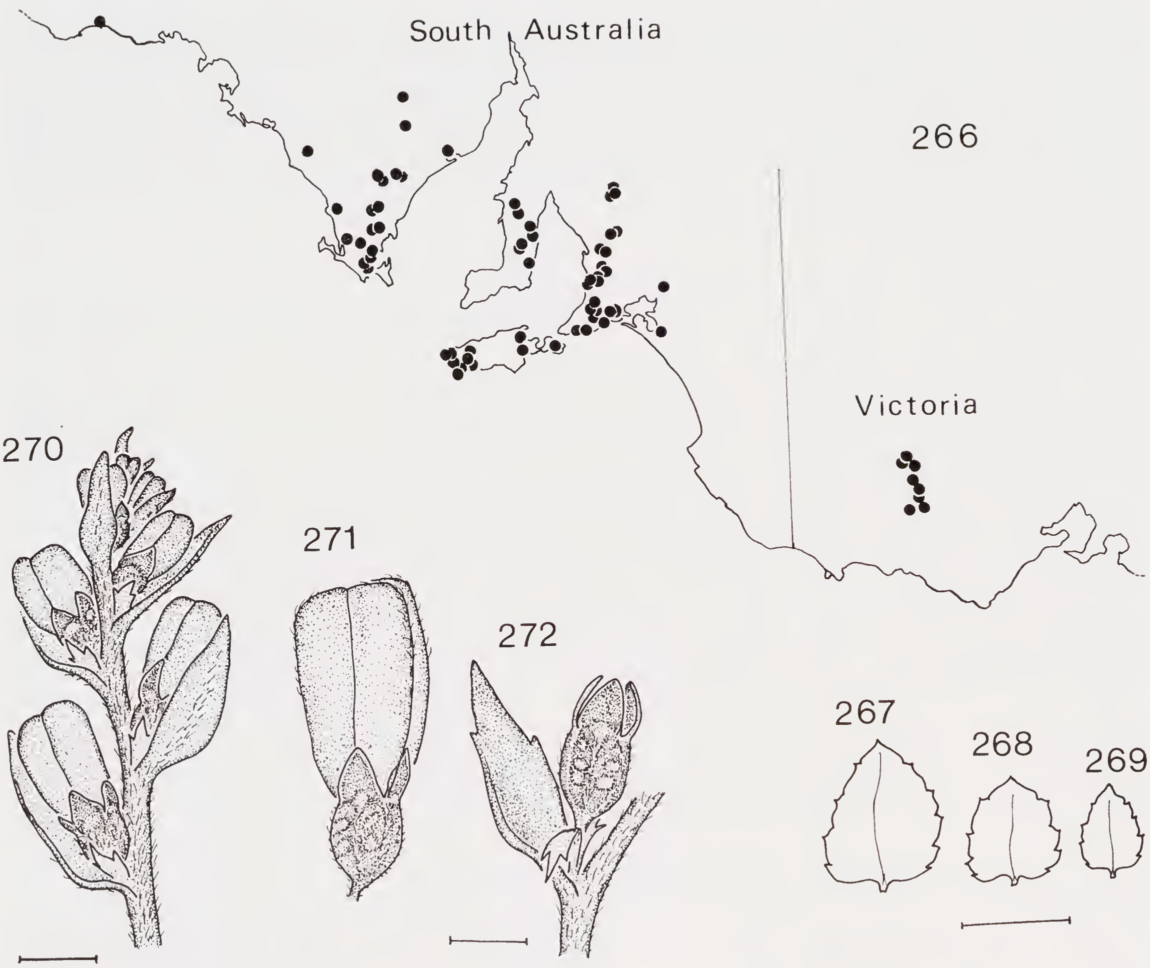
Haloragis teucrioides non (DC.) Schindl.: Sonder, Linnaea 28 (1856) 229, 230; Tate, Trans. R. Soc. S. Aust. 3 (1880) 64, 4 (1882) 106, 6 (1883) 94, 156, 12 (1889) 65, 95; Tate, Fl. S. Aust. (1890) 101, 234; Black, Fl. S. Aust. (1926) 430, (1929) 694, ed. 2 (1952) 642.

Figs.: Schindler, Pflrch 23 (1905) fig. 9B; Praglowski, Grana 10 (1970) pl. 2 (k-m).

Erect or ascending perennial herb (5-) 20-30 (-40) cm tall; stems freely branching, red-brown, strongly 4-angled, ± woody at base, herbaceous above, densely spreading or semi-appressed pilose with transparent, simple, uniseriate, 3-4-celled hairs 0.5-1.0 mm long, usually seated on small multicellular tubercles.

Leaves decussate, becoming alternate near inflorescence, (broad-ovate-) cordate, 0.7-1.7 (-2.5) cm long, (0.6-) 0.7-1.6 (-2.0) cm wide, petiole 1 mm long, densely pilose, lamina dark green above, light green below, serrate with 8-12 obliquely cuspidate teeth 1-2 mm long, midrib sunken above, prominent below, lateral veins obscure, margin thickened, moderately densely pilose on both faces with hairs as for stems, or ± glabrous on adaxial surface (Figs. 267-269).

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Lateral inflorescences arise in axils of upper (alternate) leaves. Primary bracts green, fleshy, lanceolate, (2.3-) 2.5-2.8 (-4.5) mm long, 1.0-1.2 (-2.0) mm wide, entire or weakly 2-3-toothed, sparsely pilose on abaxial surface, glabrous above. Secondary bracts red-brown, semi-hyaline, membranous, ovate, 0.7-0.9 mm long, 0.4-0.7 mm wide, deeply cut into 3-7 teeth, glabrous (Fig. 270).



Figs. 266-272. *Gonocarpus mezianus*. 266. Distribution. 267-269. Leaves. 270. Upper part of inflorescence. 271. Flower. 272. Fruit with primary and secondary bracts. (figs. 267-269, 272 from *Hunt 3064*, figs. 270, 271 from *Orchard 2583*). Scales represent 1 cm (figs. 267-269) or 1 mm (figs. 270-272).

Flowers 4-merous, on pedicel 0.4 mm long (Fig. 271). Sepals 4, reddish-green, deltoid to subcordate, 0.5-0.8 mm long, 0.4-0.7 mm wide, margins thickened, weak median basal callus and thickened midvein, glabrous. Petals 4, red hooded, keeled, very shortly unguiculate, (2.0-) 2.3-2.8 (-3.1) mm long, 0.7-0.8 mm wide, pilose on keel with curved, simple 2-3-celled hairs 0.3-0.4 mm long. Stamens 8, filaments 0.2-0.3 mm long; anthers linear-oblong, (1.5-) 2.0-2.4 mm long, 0.3-0.4 mm wide, 4-celled, nonapiculate. Styles 4, clavate, 0.4 mm long, stigmas globular, fimbriate. Ovary slate-grey, globular, 0.8-1.2 mm long, 0.8-1.3 mm wide, weakly 4-angled opposite petals, 4-ribbed opposite sepals, with 2-3 oblique calluses between ribs and angles, scabrous with appresssed white or hyaline hairs 0.1-0.2 mm long; incompletely 4-locular, 1 ovule per locule, pericarp membranous.

Fruit silver-grey to slate-grey, globular, 1.0-1.3 mm long, 0.9-1.2 mm wide, 4-angled between sepals 4-ribbed opposite sepals, with 2-3 oblique calluses between angles and ribs, scabrous; sepals persistent erect, deltoid, 0.7 mm long, 0.5-0.6 mm wide, margins thickened, weak median basal callus; 1 seed (Fig. 272).

Distribution: *G. mezianus* is known to occur on Eyre Peninsula, Yorke Peninsula, Kangaroo Island and in the Mt. Lofty Ranges and south-east of South Australia, and in the Grampians of western Victoria. One collection (*Walter NSW99015*) is recorded as coming from the Dandenong Ranges near Melbourne (Fig. 266).

Ecology: This species favours dry rocky soils, usually in full sun. Typical collectors' notes on habitat include "limestone under a shallow layer of red-brown sandy loam; open flat terrain, surrounded by

mallee scrub" (*Barker 845*); "stony sandy soil" (*Jackson 388*); "clay on basalt" (*Jackson 654*); "low underscrub of rocky loam areas, throughout Peppermint gum woodland" (*Kraehenbuehl 2283*); "on rocky slope above creek, under *Eucalyptus obliqua*" (*Orchard 1867*); "at base of *Melaleuca* scrub" (*Orchard 2992*); "on flat with *Callistemon*" (*Osborn AD96810128*); "on limestone on coastal slopes" (*Smith 564*); "on travertine limestone" (*Smith 816*). As in several other species, some plants of *G. mezianus* have flowers which are functionally female, with abortive petals and stamens (e.g. *Orchard 1867, 3031; Smith 564; Tate AD96810109; Wheeler 786*). Flowering takes place from August until February and fruiting from September until April.

Specimens examined:

SOUTH AUSTRALIA: Alcock B58, 20.viii.1964, Yallunda Flat, Hd. of Koppio, AD (fl.); *Alcock C89,* 20.xii.1964, Section 99, Hd. of Wanilla, AD (fr.); *Alcock 2320A,* 9.x.1968, 1 to 2 miles [2-3 km] in from south boundary, Hincks National Park, AD (fl.); *Bagshaw 15,* 7.xi.1923, Maitland, AD (fr.); *Barker 845,* 12.x.1970, south side of Mickey Flat Rd., ca 1½ miles [2½ km] west of Ardrossan-Port Vincent road, AD (fl.); *Barker 1465,* 21.xi.1971, ca 12 km W. of Yumali on the Yumali-Meningie road, AD (fr.); *Behr s.n.,* 1848, Bethanie, MEL39163 p.p. (fr.); *Blandowsky 40,* 1850, Carromandel Valley ad flumen Sturt, prope Port Adelaide, MEL (fl.); *Blaylock 253,* 8.x.1966, Sect. 141, Hd. of Curramulka, AD (fl.); *Blaylock 1531,* 23.viii.1970, ca 15 km east-south-east of Minlaton, AK (fl.); *Browne 41,* 1874, Port Lincoln, MEL (fr.); *Cashmore s.n.,* 14.xi.1933, Western River, Kangaroo Island, ADW1760 (fl.); *Cleland s.n.,* -.xi.1920, Waterfall Gully, AD96803104 (fl., fr.); *Cleland s.n.,* 4.i.1924, Encounter Bay, AD96803103 (fl., fr.); *Cleland s.n.,* 26.xi.1924, between Kingscote and Vivonne Bay, AD96803109 (fr.); *Cleland s.n.,* -.i.1929, Myponga, AD96803105 (terat.); *Cleland s.n.,* 15.x.1953, Caralue Bluff, AD96803126 (fl.); *Cleland s.n.,* 27.xi.1954, Upper part of South-West River, AD96803110 (fl., fr.); *Cleland s.n.,* 9.xi.1965, near Sleaford Mere, AD96918062 (fr.); *Copley 2284,* 29.ix.1968, ca 4 km north-east of Weetulta, AD (fl.); *Copley 2451,* 21.i.1969, Winters Hill, Port Lincoln, AD (fr.); *Eardley s.n.,* 17.x.1931, Christies Beach, ADW1759 (fl.); *Eardley s.n.,* 19.x.1935, Belair, ADW2428 (fl.); *Eichler 14585,* 31.xii.1957, Waterfall Gully, AD (fr.); *Eichler 18605,* 7.i.1966, Flinders Chase, near the permanent pool of Rocky River at Shackle Road, AD (fr.); *Eichler 19408,* 9.x.1967, Mt. Wedge, AK (fl.); *Galbraith s.n.,* 23.ix.1966, Port Lincoln, AD96907012 (fl., fr.); *Green 670,* 30.ix.1950, Blewitts Springs, AD (fl.); *Hilton s.n.,* 25.xi.1953, Callawonga Creek, Fleurieu Pen., ADW18602, 18603 (fl., fr.); *Hunt 2531,* 21.x.1965, between Mt. Compass and Victor Harbour, AD (fl.); *Hunt 3064,* 15.x.1969, Santa Cruz property, Waitpinga, AD (fl.); *Hunt 3087,* 26.xi.1969, Range Road in Cromptons Scrub, Waitpinga, AD (fl., fr.); *Hunt 3139,* 16.xi.1969, Comptons Scrub, Back Valley, AD (fl., fr.); *Ising s.n.,* 11.xi.1918, Belair, AD966031918 (fr.); *Ising s.n.,* 1.xi.1924, Belair, AD 966031739 (fl., fr.); *Ising s.n.,* 10.x.1928, Myponga, AD966032044 (fl.); *Ising s.n.,* 19.x.1930, National Park, Belair, AD966031748 (fl.); *Ising s.n.,* 8.xii.1930, near Crafers, AD966031816, 96830371, 96830372, 96830383 (fr.); *Ising s.n.,* 12.xi.1932, Waterfall Gully, AD96803150 (fl.); *Ising s.n.,* 20.x.1933, National Park, Belair, AD966031835 (fl., fr.); *Ising s.n.,* 4.xi.1933, National Park, Belair, AD966031745, 966032065, 96803134, 96803155 (fl., fr.); *Ising s.n.,* 12.xi.1934, Waterfall Gully, AD966032041 (fl.); *Ising s.n.,* 2.ix.1935, Carappee Hill, AD96830369 (fl.); *Jackson 388,* 18.x.1964, Kingscote Council quarries, AD (fl.); *Jackson 654,* 18.x.1969, Kingscote Council quarries, AD (fl.); *Kraehenbuehl 1174,* 27.x.1963, Tothill Range, AD (fl., fr.); *Kraehenbuehl 2162,* 29.x.1967, Central Tothill Range, AD (fl.); *Kraehenbuehl 2283,* 5.x.1968, Tarnma, Tothill Range, AD (fl.); *Mueller s.n.,* 1847, Lofty Range, MEL39147 (st.); *Mueller s.n.,* -.xi.1848, in montib. lapidosis urb. Adelaide proxim., MEL39163 (fr.); *Orchard 156, 158,* 3.ii.1968, banks of First Creek, east of Cape Jervois, AD (fr.); *Orchard 1810,* 3.xi.1968, Tookayerta Creek, ca 5 km south-east of Tooperang, AK (fl., fr.); *Orchard 1867, 1868,* 6.i.1969, upper Waterfall Gully, AD (fr.); *Orchard 2075,* 15.iv.1969, Hindmarsh Falls, AD (fr.); *Orchard 2188,* 20.ix.1969, Millbrook Reservoir, AD (st.); *Orchard 2583,* 11.x.1970, ca 6 km north-west Stansbury, AD (fl.); *Orchard 2992,* 30.xii.1970, ca 6 km west of Ungarra on road to Yeelanna, AD (fr.); *Orchard 2994,* 30.xii.1970, ca 14 km west of Ungarra on road to Yeelanna, AD (fr.); *Orchard 3031,* 31.xii.1970, ca 1 km west of Sleaford Mere on the road to Fishery Bay, AD (fr.); *Orchard 3043,* 1.i.1971, Epsom Springs, ca 16 km NNW of Port Lincoln, AD (fr.); *Orchard 3115,* 2.i.1971, Flinders Highway, ca 7 km south-south-east of Mt. Hope, AD (fr.); *Osborn s.n.,* 27.xi.1923, Rocky River, AD96810128 (fr.); *Osborn s.n.,* 28.xi.1923, Breakneck River, Flinders Chase, AD96810096 (fl.); *Parsons 16,* 3.x.1962. Sec. 251, Hd. of Parawirra, AD (fl.); *Pearce s.n.,* 28.i.1965, Coolanie, Franklin Harbour, ADW29567 (fr.); *Perry s.n.,* -.x.1944, Christies Beach, CANB 18432 (fl.); *Phillips s.n.,* 27.viii.1964, 16 miles [26 km] from Port Lincoln towards Cummins, AD96920305, CBG023584, MEL48224 (fl.); *Richards s.n.,* -.x.1882, between Port Lincoln and Streaky Bay, AD96810126 (fl.); *Rainbow s.n.,* Mt. Compass, ADW16996 (fl., fr.); *Richards s.n.,* 1883, between Port Lincoln and Streaky Bay, MEL39157, 39159 (fl.); *Rogers s.n.,* -.ix.1907, Cape Borda, NSW98865 (fl.); *Sharrad 747,* 3.ix.1960, ca 8 km south of Malinong Hall, AD (fl.); *Smith 564,* 4.x.1967, O'Sullivan's Beach, AD (fl.); *Smith 816,* 9.x.1967, Port Elliott, AD (fl.); *Smith 1521,* 13.x.1968, Highbury south of the Highbury Hotel, AD (fl.); *Specht 2600,* 11.xi.1960, Verran Hill, Hincks National Park, AD (fr.); *Spooner 277,* 4.xii.1968, Torrens Gorge, AD (fr.); *Spooner 989,* 18.xi.1970, Finniss Scrub, AD (fl., fr.); *Spooner 1341,* 12.x.1970, Sassafras Drive, Highbury, AK (fl.); *Tate s.n.,* -.x.1878, Waterfall Gully, AD96810094 (fl.); *Tate s.n.,* 9.x.1883, Brighton Cliffs, AD96810109 (fl.); *Tate s.n.,* 18.xi.1883, Dudley Peninsula, AD96810127 (fl.); *Tate s.n.,* 24.xi.1883, Belair, AD96810077 (fr.); *Tepper s.n.,* -.xi.1879, Yorke Valley, AD96810125 (fr.); *Tepper s.n.,* 15.ii.1886, Karatta, AD96811109 (fl.); *Tepper s.n.,* 2.iii.1886, Harveys Return, AD96811110 (st.); *Tepper 108,* 2.iii.1886, Harveys Return, MEL (fr.); *Tepper 338,* -.xi.1881, Clarendon, MEL (fl.); *Tepper 560,* 1879, Yorke Peninsula, MEL (fl., fr.); *Tepper 629,* 188-, Yorke Peninsula, MEL (fr.); *Tepper 1288,* 18.iii.1884, west of Queenscliff, MEL (terat.); *Whaite & Whaite 3201,* Parsons Beach, 10 miles [16 km] SW of Victor Harbour, NSW (fr.); *Wheeler 740,* 6.x.1968, summit of Verran Hill, Hincks National Park, AD (fl.); *Wheeler 786,* 7.x.1968, western slopes of Blue Range, Hincks National Park, AD (fl.); *Wheeler 1006,* 11.x.1968, Scour Creek, Hincks National Park, AD (fl.); *Whibley 327,* 10.x.1958, Marble Range, AD (fl.); *Whibley 805,* 27.ix.1960, Cunyarie Hills, AD (fl.); *Wilhelm s.n.,* 1853, Port Lincoln, MEL 39163 (st.) — holotype of *H. teucrioides* var. *glabrata*; *Wilson 326,* 8.x.1958, Stanford Hill, 8 km south-east of Port Lincoln, AD (fl.); *Wilson 654,* 2.xi.1958, Kelly Hill, ca 13 km east-north-east of Cape du Couedic, AD

(fl.); *Wilson 839,* 10.xi.1958, Western River, 6.5 km north of Playford Highway, AD (fl.); *Wilson 879,* 12.xi.1958, Stunsail Boom River, ca 68 km south-west of Kingscote, AD (fl., fr.). *VICTORIA: Ising s.n.,* 6.i.1927, Epacris Falls, Grampians, AD (fr.); *Ising 2319, 2619,* 6.i.1927, Mt. Victoria, Grampians, AD (fr.); *Meebold 2255,* - i.1929, Grampians, M (st.); *Mueller s.n.,* Nov. Holland meridionalis, LE (st.) — syntype of *H. meziana*; *Orchard 1893, 1897, 1898,* 8.ii.1969, Cultivation Creek gorge, Victoria Range, AD (fr.); *Orchard 1922,* 9.ii.1969, Mt. Victory-Halls Gap road, AD (fr.); *Orchard 1937,* 10.ii.1969, ca 2 km north of Halls Gap on Roses Gap track, AD (fr.); *Orchard 1939,* 10.ii.1969, Deep Creek, ca 15 km north of Halls Gap on track to Mt. Zero, AD (fr.); *Orchard 1943, 1944, 1952, 1955,* 10.ii.1969, Golton Creek, ca 29 km NW of Halls Gap, AD (fl., fr.); *Phillips s.n.,* 13.x.1966, Flat Rock, Grampians, CBG017054 (fl.); *Schomburgk s.n.,* Australia, LE (st.) — syntype of *H. meziana*; *Sullivan 13,* 12.xi.1873, Mt. Wm., MEL (fl.); *Symon 1722A,* 1.xi.1961, W. of Mirranatwa Gap, Grampians, ADW (fl.); *Tilden 919,* -.xii.1912, Halls Gap, BISH (2 sheets) (fl.); *Walter s.n.,* -.xi.1897, Dandenong Ranges, NSW99015 (fl., fr.); *Walter s.n.,* Grampians, MEL39166 (st.) — lectotype of *H. meziana*; *Walter s.n.,* Grampians, NSW87862 (st.) — isolectotype of *H. meziana*; *Williamson s.n.,* -.xi.1904, Grampians, MEL39165 (fl.); *Williamson 26,* 1893, Mt. Abrupt, MEL (fr.); *Williamson 52,* -.x.1900, Grampians, NSW (st.); *Wrigley s.n.,* 1.xii.1968, 45 miles [72 km] from Horsham towards Halls Gap, AD, CBG031348 (fl.).

Black (1926, 1952) considered that this species was only a variety of *G.* ('*Haloragis*') *teucrioides* DC. Curtis (1956) further reduced the species to synonymy under *Haloragis teucrioides.* Willis (1972), while treating *H. meziana* as a distinct species, remarked that "the differences purporting to separate this taxon from the succeeding species, *H. teucrioides,* appear to be rather trifling". However, the two taxa are easily distinguished by their bracteoles (green, fleshy, entire, scabrous, exceeding and ± concealing ovary in *G. teucrioides*; reddish, membranous, laciniate, glabrous, shorter than the ovary in *G. mezianus*), habit (*G. teucrioides* is erect, sparsely branched; *G. mezianus* is usually a weaker more profusely branched subshrub), indumentum (hairs coarse, spreading in *G. teucrioides*; finer, ± appressed in *G. mezianus*); and inflorescence (lower flowers opposite in *G. teucrioides,* alternate in *G. mezianus*). The confusion seems to have arisen because Schindler (1905) included a Tasmanian specimen (Mueller, LE) in his list of syntypes. This specimen has been re-examined, and although sterile, can safely be referred to *G. teucrioides.* The remaining syntypes are conspecific and closer to Schindler's description. One of these (*Walter s.n.,* MEL) has been chosen as lectotype of *H. meziana.*

A clinal variation in indumentum is observable across the range of this species. In western South Australia the hairs are relatively sparse and closely appressed, while in western Victoria they are more dense and ± spreading. Leaf size is also very variable in this species, depending apparently to a large extent on the degree of shading.

Hybrids between *G. mezianus* and *G. elatus* are fairly common, the progeny being intermediate in all characters. The best documented case of this is the series of collections *Orchard 1942 - Orchard 1955* from Golton Creek in the Grampians (see under *G. elatus*). The type specimen of *Haloragis teucrioides* var. *lanceolata* Sonder (1856) is also a hybrid between *G. elatus* and *G. mezianus.*

18. **Gonocarpus elatus** (A. Cunn. ex Fenzl) Orchard (Figs. 273-275)

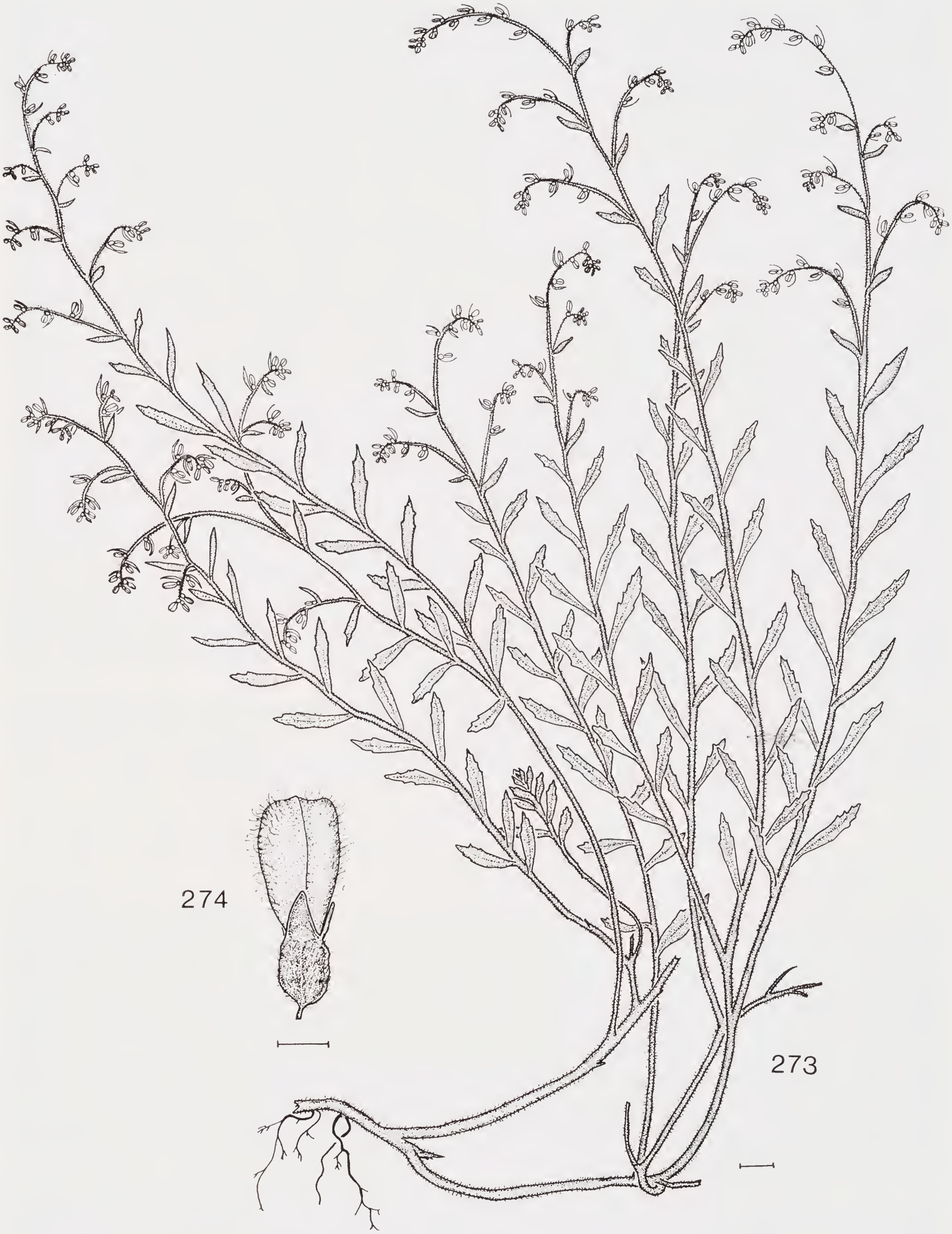
Gonocarpus elatus (A. Cunn. ex Fenzl) Orchard, comb. nov.

Haloragis elata A. Cunningham ex Fenzl, Enum. Pl. Hueg. (1837) 45 [Typus: "In sterilius interioribus New South Wales. (Cunningh.)". Holotypus: *Anon s.n.,* 1825, barren interior N.S. Wales, W (fl.)! Isotypi: *A. Cunningham s.n.,* 1825-1836, barren country, interior N.S. Wales, G (herb. DC., 2 sheets) (fl., fr.)!; Syntypi (?): *A. Cunningham 28,* 1825, Molong Plain, MEL39262 (fl.)!; *A. Cunningham 46,* -.x.1825, Wellington Valley, BRI 017691!, K! (fl.)] Walp., Rep. 2 (1843) 99; Schldl., Linnaea 20 (1847) 648; A. Gray, Bot. U.S. Expl. Exped. 1 (1854) 626; Benth., Fl. Aust. 2 (1864) 477; F. v. M., Fragm. 8 (1874) 162; Tate, Trans. R. Soc. S. Aust. 3 (1880) 64; F. v. M., Census 1 (1882) 49; F. v. M., Key Syst. Vict. Pl. 2 (1885) 22, 1 (1887-8) 262; F. v. M., Trans. R. Soc. Vict. 24 (1888) 134; Cleland, Trans. R. Soc. S. Aust. 10 (1888) 78; F. v. M., Sec. Census 1 (1889) 85; Tate, Fl. S. Aust. (1890) 101, 234; Moore, Hdbk. Fl. N.S. Wales (1893) 185; Petersen, Pflfam. III. 7 (1893) 233; Bailey, Qld. Fl. 2 (1900) 554; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 35; Schindler, Pflrch 23 (1905) 27; Dixon, Pl. N.S. Wales (1906) 130; Bailey, Comp. Cat. Qld. Pl. (1913) 174; Maid. & Betche, Census N.S. Wales Pl. (1916) 158; Black, Trans. R. Soc. S. Aust. 41 (1917) 49, 43 (1919) 39; Black, Fl. S. Aust. (1926) 430; Ewart, Fl. Vict. (1931) 880; Black, Fl. S. Aust. 2 ed. (1952) 642; Eichler, Suppl. Black's Fl. S. Aust. (1965) 245; Praglowski, Grana 10 (1970) 168; Burbidge & Gray, Fl. A.C.T. (1970) 279; Willis, Hdbk Pl. Vict. 2 (1972) 467; Beadle et al., Fl. Syd. Reg. (1972) 206.

Haloragis tenuis Schindler, Pflrch 23 (1905) 27, 28 [Typus: "Australien: Neu-Süd-Wales, bei Quirindi (McDonald in herb. bot. Gard. Sydney n. 7) — Herb. Berlin." Holotypus: n.v., probably destroyed. Isotypi: *W. McDonald s.n.,* -.xi.1903, Quirindi, MEL39302 ex NSW!, NSW113170 ("7")! (fl., fr.)] Maid. & Betche, Proc. Linn. Soc. N.S. Wales 31 (1906) 397; Maid. & Betche, Cens. N.S. Wales Pl. (1916) 158.

FIGS.: Petersen, Pflfam. III. 7 (1893) fig. 102F; Schindler, Pflrch 23 (1905) fig. 7; Black, Fl. S. Aust. 2 ed. (1952) fig. 872.

Erect or ascending perennial herb or subshrub, 18-35 (-60) cm tall, stems slightly 4-5-ribbed, densely spreading pilose with soft, transparent, 3-celled hairs 0.4-1.0 mm long (Fig. 273).



Figs. 273, 274. *Gonocarpus elatus*. 273. Habit. 274. Flower. (figs. 273, 274 from *Orchard 1813*). Scales represent 1 cm (fig. 273) or 1 mm (fig. 274).

Leaves sessile, all alternate or lowest 1-2 pairs subopposite, linear-lanceolate to ovate, (1.0-) 1.8-3.0 (-5.2) cm long, (1.0-) 2.0-5.0 (-8.0) mm wide, ± entire or toothed in upper half only, margins revolute, midrib prominent below, channelled above, ± densely pilose on both surfaces with hairs 0.3-0.8 mm long, as for stems.

Inflorescence an indeterminate spike of single flowers in the axils of primary bracts, with lateral spikes in the axils of the upper leaves, all characteristically drooping in their upper halves. Primary bracts leaflike, equal to or smaller than the flowers in length, 2.0-3.0 mm long, 0.5-0.7 mm wide, pilose with hairs as for stems and leaves. Secondary bracts brown, membranous, lanceolate, 0.8-1.0 (-1.5) mm long, 0.3-0.4 mm wide, pilose with 1-3-celled transparent hairs 0.2-0.3 mm long on margins and abaxial face, glabrous on adaxial face.

Flowers 4-merous, on pedicel 0.3-0.4 mm long, solitary in axil of primary bracts, subtended by two secondary bracts (Fig. 274). Sepals 4, green, deltoid, 0.6-0.8 mm long, 0.4-0.5 mm wide, with median basal hemispherical callus, margins thickened, glabrous. Petals 4, reddish-brown with yellow-green margins, ± hooded, 2.1-2.7 mm long, 0.6-0.7 mm wide (keel to margin), glabrous except for 3-4 rows of spreading transparent 3-celled hairs 0.3-0.5 mm long on keel. Stamens 8, filaments 0.2-0.3 mm long; anthers linear-oblong, 2.0-2.3 mm long, 0.3 mm wide, yellow to reddish. Styles 4, 0.4 mm long, stigmas yellowish, shortly fimbriate. Ovary globose to ovoid, 0.9-1.2 mm long, 0.8-1.0 mm wide, ± 8-ribbed longitudinally, with 3-4 transverse rows of tubercules or sometimes irregularly tuberculate or almost smooth, white to slate grey or brown, ± densely pilose with semi-appressed 3-celled hairs 0.1-0.2 mm long or occasionally almost glabrous, incompletely 4-celled, septa spongy, columella present, ovules 4.

Fruit variable, globose to ovoid, (0.9-) 1.2-1.5 mm long, 0.7-1.1 mm wide, ± distinctly 8-ribbed, verrucose as for ovary or almost smooth, appressed pilose, sometimes becoming almost glabrous at maturity; sepals persistent, enclosing the styles, (0.6-) 0.8-1.0 mm long, 0.4-0.5 mm wide; 1 seed, filling whole fruit.

Distribution: *G. elatus* occurs in the Gawler, Flinders and Mt. Lofty Ranges in South Australia, the Grampians, Gippsland and central mountainous region of Victoria, in central and northern New South Wales, with an isolated pocket near Broken Hill, and in a few isolated localities in Queensland (Fig. 275).

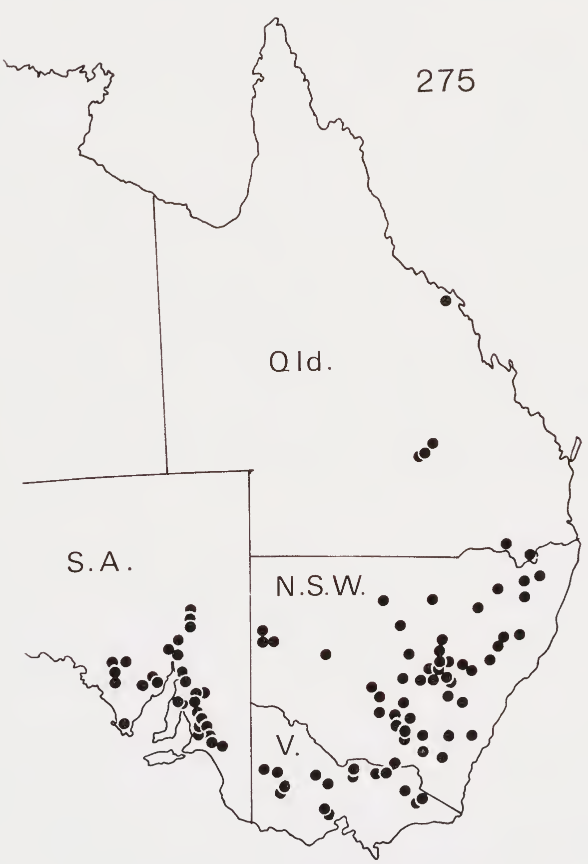


Fig. 275. Distribution of *Gonocarpus elatus*.

Ecology: This species favours exposed positions in full sun, usually among rocks and boulders in hilly or mountainous country. This is frequently stated in collectors' notes. Its distribution closely follows the limits of the 35-75 cm/annum rainfall area in temperate south-eastern Australia. Burke (NSW98987) stated "spring time bees worked the blossoms very freely for pollen" and Butler (NSW98973) recorded that "sheep will eat it in a dry time but not when there is other feed about." Flowering occurs from October to December, occasionally as early as April or May or as late as January, and fruits are present from (October-) November to March.

Specimens examined:

QUEENSLAND: Bailey s.n., Stanthorpe, BRI080115 (fl.); *Biddulph s.n.,* 1890, Springsure, MEL1003707 (fl.); *Biddulph s.n.,* 1890, Mt. Playfair, MEL1003716, 1003756 (fl., fr.); *Biddulph s.n.,* 1890, Cungelella, MEL39477, 1003504, 1003737 (fl., fr.); *Johnson & Constable s.n.,* 10.xi.1954, 1 mile [2 km] E. of Yelarbon, NSW30383 (fl.); *O'Shanesy s.n.,* Table Mountain, MEL1003500 (st.); *O'Shanesy Ser. 7, No. 98,* 12.xii.1867, in sheltered places among rocks near Table Mt., MEL (st.). *NEW SOUTH WALES: Anon. s.n.,* 1825, barren interior N.S. Wales, W (fl.) — holotype of *H. elata; Abrahams s.n.,* -.x.1911, Dubbo, NSW103145 (fl.); *Abrahams 324,* -.ix.1910, Wittagoona, NSW (fl.); *Andrews s.n.,* -.ix.1918, Broken Hill, NSW98998 (fl.); *Baker 10,* 6.x.1917, Kildary, NSW (fl.); *Baeuerlen s.n.,* -.xii.1902, Wellington, NSW98976 (fl., fr.); *Beadle s.n.,* -.viii.1941, Tottenham, SYD (fl.); *Beadle s.n.,* 6.xii.1950, Co. Bourke, SYD (fr.); *Betche s.n.,* -.x.1883, Harvey Range near Dubbo, NSW98975 (fl.); *Betche s.n.,* 6.x.1886, Girilambone, NSW98989 (fl.); *Betche 8,* -.v.1910, Barren rocks near Dubbo, MEL (fl.); *Blakely s.n.,* -.xi.1907, Bowan Park, BRI079996 (fr.); *Blakely 77,* -.x.1906, Bowan Park near Cudal, NSW (fl.); *Boorman s.n.,* -.xi.1905, Harvey Ranges, Peak Hill, NSW99093 (fl., fr.); *Boorman s.n.,* -.xi.1906, Bogan Gate, AD96920059 (fr.); *Boorman s.n.,* -.xi.1906, Manildra, NSW98985 (fl.); *Boorman s.n.,* -.xi.1906, Rockley, NSW 99094 (fr.); *Boorman s.n.,* -.xi.1906, Molong, AD96905135, SYD (fl.); *Boorman s.n.,* -.i.1911, Torrington, NSW 103129 (fl.); *Boorman s.n.,* -.i.1917, Girilambone, NSW103133 (fr.); *Boorman s.n.,* -.iii.1917, Chandlers Peak, Guyra, AD96920071 (fr.); *Boorman s.n.,* 21.xi.1917, Temora, BRI080111, NSW98981 (fl.); *Boorman s.n.,* 8.i.1918, Wyalong, NSW98979 (fl., fr.); *Burgess 1,* 19.vi.1959, near Boundary Creek about 30 miles [48 km] E.N.E. from Glen Innes, NSW (st.); *Burke s.n.,* -.x.1950, Binya, NSW98987 (fl.); *Burkitt s.n.,* 1877, Between the Darling and Lachlan (Rivers), MEL1003502 (fr.); *Butler s.n.,* -.xi.1950, Gilgandra, NSW98973 (fl.); *Cambage 1074,* 13.x.1904, Dubbo, NSW (fl.); *Cambage 1736,* 29.ix.1907, Torrington, NSW (st.); *Cambage 2465,* 7.xi.1909, Barber's Pinnacle, Boggabri, NSW (fr.); *Cambage 2532,* 30.x.1909, Mt. Wingen, NSW98984, SYD (fl., fr.); *Cambage 2584,* 30.x.1909, Dunwell Scone, CANB7207, NSW98978, SYD (fl.); *Cambage 4194,* 30.ix.1916, Ardlethan, NSW103132 (fl.); *Cleland s.n.,* -.iii.1915, Dubbo, NSW103139 (fr.); *Constable s.n.,* 27.x.1959, Bosche's Creek, ca 16 miles [26 km] north of Orange, AD96043031, NSW48931 (fl.); *Constable 5163,* 21.x.1964, The Rock, NSW (fl.); *Constable 7261,* 7.xii.1966, Cocoparra Range, 4 miles [6.5 km] by road south-west of Rankin's Springs, BISH, NSW (fl., fr.); *Cunningham s.n.,* 1825, barren country interior N.S. Wales, G (herb. DC.) (fl., fr.) — isotype of *H. elata*; *Cunningham 28,* 1825, Molong Plain, MEL (fl.) — ? syntype of *H. elata*; *Cunningham 46,* -.x.1825, Wellington Valley, BRI, K (fl., fr.) — ? syntypes of *H. elata*; *Cunningham 830,* 18.vii.1969, Boppy Mount, NSW (fl.); *Curtin 295,* 25.xi.1953, Murda State Forest (ca 8 miles [13 km] N.E. of Condobolin), NSW (fl.); *Dwyer 757,* -.x.1915, Temora, NSW (fl.); *Dwyer 948,* -.xi.1916, Temora, NSW (fl.); *Fletcher s.n.,* -.x.1889, Wagga, NSW98982, 98992, 98993, 103138 (fl.); *Forsyth s.n.,* -.x.1907, Warrumbungle Ranges, NSW113159 (fl.); *Fraser & Vickery s.n.,* 13.i.1935, Burrinjuck, SYD (fr.); *Garland 47,* 1887, Bet. Murrumbidgee & Lachlan River, MEL (fl.); *Gauba s.n.,* 19.xi.1949, Cavan Gap, AD96911099, CBG013196 (fl.); *Gauba s.n.,* 29.xii.1949, Mount Majura, CBG013195 (fl., fr.); *Gray 5933,* 11.iv.1966, Mt. Ainslie, CANB (fl.); *Harding s.n.,* -.ix.1931, Broken Hill Racecourse, ADW16993 (fl.); *Ising s.n.,* 14.x.1921, Umberumberka ca 25 km north-west of Broken Hill, AD96830373 (fl.); *Jacobs 189,* 13.xi.1971, Manara Range, NSW (fr.); *Johnson & Briggs 2305,* 29.ix.1968, Mt. Nowbri, NSW (fl.); *MacDonald s.n.,* -.xi.1903, Quirindi, MEL39302, NSW113170 (fl., fr.) — isotypes of *H. tenuis*; *Madsen s.n.,* -.xi.1949, Baldry District, NSW98983 (fl.); *Maiden s.n.,* -.x.1896, Wagga Wagga, NSW103282 (fl.); *McBarron 2698,* 28.xi.1948, Monument Hill, Albury, NSW (fl.); *McBarron 2998,* 22.i.1949, Nail Can Hill, Albury, NSW, SYD (fr.); *McKee 413,* 10.i.1953, 15 miles [24 km] E. Rylestone, SYD (fr.); *Moore 38,* 6.x.1886, Giriligambone, MEL (fl.); *Moore M754,* 9.x.1947, Dubbo-Tomingley, CANB (fl.); *Moore M801,* 12.x.1947, Wellington, CANB (fl.); *Morris 485,* -.xi.1920, Broken Hill, NSW (fl.); *Morris 615,* 3.vii.1921, Broken Hill, NSW (fl.); *Morris 699,* 4.ix.1921, Mt. Robe, NSW (fl.); *Morton s.n.,* Between the Upper Bogan & Lachlan, MEL1003503, NSW98994 (fl., fr.); *Passlow s.n.,* 27.v.1967, Ariah Park, NSW98968 (st.); *Perks s.n.,* 12.xi.1970, Minore, NSW132774 (fr.); *Phillips s.n.,* 25.x.1966, The Rock, CBG031678 (fl.); *Rodway s.n.,* -.xi.1927, Burrier, Shoalhaven River, NSW98970 (fl.); *Sainty 247,* 4.x.1966, Wumbulgal near Griffith, NSW (fl.); *Shoebridge s.n.,* 2.xii.1961, 20 miles [32 km] south of Orange, CBG015575 (fl., fr.); *Thackeray s.n.,* 22.viii.1956, Gundagai district, NSW98977 (st.); *Thom 2,* 1887, Wagga Wagga, MEL (fl.); *Thompson 63,* 8.ix.1969, 21 miles [34 km] N.E. of Byrock, NSW (fl.); *Tindale s.n.,* 29.x.1963, Marsden, AD96401024 (fl.); *Tucker 213,* 1879, Lachlan River, MEL (fl., fr.); *Wales s.n.,* -.xi.1949, Gungal, NSW98060 (fr.); *Whaite & Whaite 2780,* 5.x.1963, Carinya Station, NSW (fl.); *Woolls s.n.,* Castlereagh, MEL1003495 (st.); *Woolls s.n.,* Mudgee, MEL1003512 (fl.). *VICTORIA: Anon s.n.,* Dry barren ranges on the Avon (River), MEL1003488 (fl.); *Beauglehole 17015,* -.x.1948, Mt. Arapiles, BEAUG (fl.); *Beauglehole 17565,* -.x.1945, Werribee Gorge, BEAUG (fl.); *Beauglehole 29602,* 19.xi.1968, Mt. Arapiles, BEAUG (fl.); *Beauglehole 29784,* 23.xi.1968, Mt. Arapiles, BEAUG (fl.); *Beauglehole 29999,* 10.xii.1968, Mt. Bepcha, BEAUG (fl.); *Beauglehole 30322,* 19.i.1969, Grampians, Mt. Rosea Track ± 1 m [2 km] east of Moora Track, BEAUG (fr.); *Beauglehole & Corricks 17841,* Mt. Zero-Stapylton area, BEAUG (fl.); *Beauglehole et al. 33242,* 6.i.1970, Suggan Buggan, AD, BEAUG (fl., fr.); *Beauglehole et al. 33387,* 7.i.1970, Ballantyne Needles, E. of Wulgulmerang, BEAUG (fl., fr.); *Canning s.n.,* 27.x.1967, 4 ml. [6 km] from Springhurst, CBG024524 (fl.); *Davis s.n.,* 1890, Wimmera, MEL1003482, 1003483 (fl.); *Fullager s.n.,* Little River, MEL39434 (st.); *Gauba s.n.,* 30.xi.1945, Tatura, AD96911102, CBG013197 (fr.); *Matthew s.n.,* Grampians, AD96906036 (fl.); *Matthew s.n.,* Stawell, AD96905143, NSW99002 (fr.); *Moore M205,* 17.ii.1946, Wangaratta-Thoona, CANB54669 (st.); *Mueller s.n.,* Australia felix, MEL1003786 (fl.); *Orchard 1918,* 9.ii.1969, Grampians, Mt. Rosea Track, AD, AK (fr.); *Orchard 1945, 1948, 1950, 1953,* 10.ii.1969, Golton Creek, AD

(fr); *Orchard 1956,* 10.ii.1969, Mt. Zero, AD (fl., fr.); *Orchard 2482,* 25.viii.1970, Ballantyne Hills, Suggan Buggan, AD (st.); *Orchard 2780,* 6.xii.1970, Bald Hill, above headwaters of Boundary Creek, ca 4 km north-east of Wulgulmerang, AD971040340 (fl.); *Reader s.n.,* 19.xi.1892, Shire of Dimboola, MEL1003490 (fl.); *Reader s.n.,* 3.xi.1895, Mt. Arapiles, MEL1003489 (fl., fr.); *Reader 6,* 3.xi.1895, Mt. Arapiles, MEL (fl., fr.); *Reader 9,* 1892, Wimmera, MEL (fl.); *Robbins ACB17037,* 29.ix.1947, Wedderburn, BEAUG (fl.); *Robbins ACB17109,* ca 1940, Bendigo, BEAUG (fl.); *St. John s.n.,* 7.xii.1912, Lerderderg River, Bacchus Marsh District, MEL1003481 (fl., fr.); *Sullivan 2,* -.xi.1882, Black Range near Stawell, MEL (fl., fr.); *Walters s.n.,* -.xi.1899, Grampians, NSW113160 (fl.); *Watts 1291,* -.x.1918, nr. Wedderburn, MEL (fl.); *Williamson s.n.,* -.xii.1900, Mt. Arapile, NSW99000 (fr.). *SOUTH AUSTRALIA: Alcock 847,* 7.xi.1965, Section 17, Hd. of Charleston, AD (fl., fr.); *Barker 730,* 12.x.1969, near Cascades on Reedy Creek, AD (fl.); *Beck 1427,* -.x.1924, Wilpena Pound, AD (fl.); *Behr 164,* Barossa Range, G (herb. Boiss.), MEL (fl.); *Black12,* -.xi.1903, Port Lincoln, NSW (fl.); *Blandowsky s.n.,* 1850, Carromandel Valley, MEL1003510, 1003511, 1003521 (fr.); *Blandowsky 39,* 1850, Carromandel Valley, MEL (fl., fr.); *Brummit s.n.,* 3.x.1893, Blackwood, AD96211066 (fl.); *Cleland s.n.,* Warren Reservoir, AD96808373 (fl.); *Cleland s.n.,* -.xi.1920, Waterfall Gully, AD96808401 (fl.); *Cleland s.n.,* 23.ix.1922, Kinchina, AD96808368 (fl.); *Cleland s.n.,* 8.xi.1924, Kinchina, AD96808384 (fr.); *Cleland s.n.,* 20.x.1927, Mt. Remarkable, AD96808356 (fl.); *Cleland s.n.,* 10.xi.1928, Wilpena Pound, AD96808353 (fl., fr.); *Cleland s.n.,* 15.xi.1928, Wilpena Pound, AD96803111 (fl.); *Cleland s.n.,* 2.i.1933, Waterfall Gully, AD96803154 (fr.); *Cleland s.n.,* -.xi.1936, Iron Knob, AD96808352 (fl., fr.); *Cleland s.n.,* 8.xi.1936, Mt. Remarkable, AD96808388 (fl.); *Cleland s.n.,* 16.xi.1938, Hallett, AD96808389 (fl.); *Cleland s.n.,* 16.xii.1939, National Park, Belair, AD96808405 (fl.); *Cleland s.n.,* 22.xi.1942, Waterfall Gully, AD96808386 (fl., fr.); *Cleland s.n.,* 28.xi.1942, Morialta, AD966032581 (fr.); *Cleland s.n.,* 28.xii.1943, 30.xii.1944, National Park, Belair, AD96808370 (fr.); *Cleland s.n.,* 28.xi.1958, Ferguson Park, Stonyfell, AD96808385 (fl.); *Cooper s.n.,* 20.xi.1957, Alligator Gorge, AD96404245 (fl.); *Cooper s.n.,* 24.ix.1964, ca 1.6-6.0 km east of Melton Siding, AD96509267 (fl.); *Copley 792,* 20.x.1966, Barunga Range, AD (fl.); *Copley 859,* 6.xi.1966, Railway Reserve above Lochiel turnoff on Bute-Snowtown road, AD (fl.); *Copley 2886,* 9.xi.1969, South Hummocks Range, AD (fl.); *Copley 3263,* 15.xi.1970, ca 1.6 km east of Sevenhills, AD (fl.); *Czornij 243,* 21.xi.1968, Black Hill, AD (fl., fr.); *Donner 1238,* 1.xii.1964, Mt. Barker Summit, AD (fl.); *Eichler 12077,* 7.xii.1955, Hill near Black Springs, AD (fr.); *Eichler 12745,* 19.ix.1956, Gammon Ranges, AD, AK (fl.); *Eichler 14584,* 31.xii.1957, Waterfall Gully, AD (fr.); *Green 695,* 8.x.1950, Morialta Reserve, AD (fl.); *Hall s.n.,* 8.xi.1964, ca 1.6 km below Gorge Creek deposits, AD96901335 (fl., fr.); *Hilton s.n.,* 18.iii.1954, Kanmantoo, ADW18601 (fr.); *Hogan s.n.,* Waterfall Gully, AD968061223 (fl.); *Ising s.n.,* 17.xi.1917, Burnside, AD96830389 (fl.); *Ising s.n.,* 21.x.1924, Mount Maria, AD96830367, 96830388 (fl., fr.); *Ising s.n.,* 23.x.1928, Alligator Creek, AD96830360 (fl.); *Ising s.n.,* 25.x.1928, Mt. Remarkable, AD966032006 (fl.); *Ising s.n.,* 16.x.1930, 24.x.1930, Kinchina, AD96830365, 966031974 (fl.); *Ising s.n.,* 12.xi.1932, Waterfall Gully, AD96803136, 966032009 (fl.); *Ising s.n.,* 1.ix.1935, Wudinna Hill, AD96833191 (fl.); *Ising s.n.,* 2.ix.1935, Waddikee Rock, AD96830384 (fl.); *Ising s.n.,* 30.xii.1935, Nairne, AD966031949 (fr.); *Ising s.n.,* 8.x.1937, Warpoo near Lyndoch, AD966031981 (fl.); *Ising s.n.,* 13.ix.1938, Gawler Range, AD96909047, 96803127 (fl.); *Ising s.n.,* 20.ix.1939, Mt. Wudinna, AD96803101 (fl.); *Ising s.n.,* 2.x.1939, Chilpuddie Rocks, AD96830374 (fl.); *Ising 540,* -.x.1918, Mt. Patawurta, Moolooloo Stn., AD (fl.); *Ising 634,* 1.x.1918, Owieanagan, Moolooloo Stn., AD (fl.); *Koch 587,* -.x.1901, Flinders Range, NSW (fl., fr.); *Kraehenbuehl 748,* 13.x.1962, Mt. Serle, AD (fl.) — pollen sent to Palyn. Lab. Stockholm; *Kraehenbuehl 808,* 22.x.1962, Blue Gum scrub south of Highbury Hotel, AD (fl.); *Kraehenbuehl 1173,* 27.x.1963, Tothill Range, AD (fl.); *Kraehenbuehl 1527,* 27.xi.1965, about 1 km south of Freeling, AD (fl.); *Kraehenbuehl 2197,* 29.x.1967, Central Tothill Range, AD (fl.); *Lothian 3695,* 17.xi.1966, Sandy Creek Wild Life Reserve, AD (fl.); *Lothian 5046,* 1.x.1969, Radium Creek on Arkaroola Station, AD (fl.); *Mueller s.n.,* -.x.1857, Cudnaka, near Lake Torrens, MEL1003520, NSW99001 (fl.); *Mueller s.n.,* 2.iii.1848, Mount Lofty Ranges, MEL39144 (fl.); *Mueller s.n.,* -.xi.1848, montium Lofty range, MEL1003769, 1003788; *Mueller s.n.,* -.x.1848, inter montana Barkerianum & fluvium Murray, MEL1003507 (fl.); *Mueller s.n.,* Barossa range, MEL1003506 (fl.); *Orchard 1813, 1815,* 21.xi.1968, Black Hill, AD (fl.); *Orchard 1823,* 21.xi.1968, ca 1½ km from Cherryville turnoff on Montacute road, AD (fl.); *Parsons 151,* 9.x.1962, Section 31, Hd. of Barossa, AD (fl.); *Phillips s.n.,* 22.viii.1964, St. Mary's Peak, Wilpena, CBG010750 (fr.); *Salasoo 1713,* 1.i.1959, between Gawler and Williamstown, NSW (fr); *Smith 1067,* 15.xii.1967, Montefiore Hill, North Adelaide, AD (fl.); *Specht & Carrodus 67,* 15.xi.1958, 12 miles [19 km] S.W. Nonning Homestead, AD (fr.); *Spooner 1293,* 24.x.1970, Modbury, AD (fl.); *Spooner 1979,* 30 vii.1972, Black Hill, Athelstone, AD (fl., fr.); *Sullivan s.n.,* Gawler Ranges, MEL39441, 1003518 (fl.); *Symon 972,* 17.xi.1960, creek at Wilpena, ADW (fl., fr.); *Symon 6753,* 26.viii.1969, Palmer, ADW (st.); *Tate s.n.,* 9 xi.1879, Torrens Gorge, AD96810062 (fl.); *Tate s.n.,* 10 i.1880, Belair, AD96810046 (fr.); *Tate s.n.,* 9.xi.1881, Coromandel, AD96810014 (fl.); *Tepper 21,* Callington, MEL (fr.); *Tepper 48,* 24.xi.1887, Monarto, AD (fr.); *Tepper 48,* 25.xi.1887, Murray Bridge, MEL (fr.); *Whibley 379,* 15.x.1958, Minnipa Hill, AD (fl.); *Wilson 523,* 16.x.1958, Gawler Ranges, Yandinga Falls, AD (fl.); *Wrigley 7765,* 26.xi.1968, 15 miles [24 km] from Lobethal towards Adelaide, CBG (fl., fr.).

G. elatus is a very variable species, extremely sensitive to its environment, especially in the size and shape of its leaves. In full sun the leaves are leathery, short and narrow (as small as 0.7-1.5 cm long and 0.2 cm wide in *Constable s.n.* and *Kraehenbuehl 748*) with entire, strongly revolute margins, whereas in shade the leaves are soft, with margins not revolute and serrate in the upper part, and up to 5 cm long and 0.8 cm wide. However, in contrast to the changes in leaf shape, the inflorescence always assumes its characteristic drooping appearance.

Three collections exist of completely glabrous forms of *G. elatus,* found in widely separated localities. In the case of the Beauglehole collection at least, the glabrous plants were growing in a population of normal pilose plants. For these reasons they do not seem to warrant formal taxonomic status. The collections are: *Beauglehole 29785,* 23.xi.1968, Mt. Arapiles, Victoria, BEAUG (fl.); *Richards s.n.,* -.ix.1886, locality unknown, MEL1003754 (fl.); *Tepper 1443,* 1890, Middle Back [Range] Port Augusta, South Australia, MEL (fl.).

The type specimens of *H. tenuis* differ from typical *G. elatus* only in their glabrous ovary. In all other respects they are typical of the sun form of the latter species, and there is therefore little justification for attempting to maintain both names.

Some collections of *G. elatus* show characters suggestive of introgression with species such as *G. mezianus*, *G. teucrioides* and *G. tetragynus*. Apparently only one mass collection exists of specimens from a hybrid swarm between *G. elatus* and another species. This is the series *Orchard 1942-1955* collected at Golton Creek in the Grampians on 10.ii.1969 and housed in AD. Of these collections, numbers *1945, 1948, 1949, 1950* and *1953* show affinity with *G. elatus*, numbers *1943, 1952* and *1955* show affinity with *G. mezianus* and the rest form a more or less continuous series between the two apparent parent species.

Other *G. elatus* × *G. mezianus* collections noted are listed below.

SOUTH AUSTRALIA: Hogan s.n., Waterfall Gully, AD986061226 (fl., fr.); *Kraehenbuehl 1923*, 20.viii.1966, McLaren Flat, AD (st.); *Mueller s.n.*, Mt. Lofty Ranges, MEL1003771 (fl.) — holotype of *Haloragis teucrioides* var. *lanceolata* Sonder; *Parsons 14*, 27.x.1961, Echunga, AD (fr.); *Spooner 279A*, 13.xi.1968, Torrens Gorge, AD (fl., fr.); *Tepper s.n.*, 15.ii.1886, Karatta, AD96811109 (fl.); *Tepper 1214*, 12.xi.1882, Morphettvale, AD (fl.).

The type specimens of *Haloragis tetragyna* var. *hispida* Benth. are also most likely hybrids of *G. elatus*. In this case the other parent may be *G. oreophilus*.

19. **Gonocarpus acanthocarpus** (Brongn.) Orchard (Figs. 276-278)

Gonocarpus acanthocarpus (Brongn.) Orchard, comb. nov.

Haloragis acanthocarpa Brongniart in Duperrey, Voy. Coq. Bot. (1829-34) t. 70 [Typus: None cited. Holotypus: *D'Urville s.n.*, Offak (Waigiou), P (fr.) photo!] F. v. M., Fragm. 8 (1874) 162; Bailey, Qld. Fl. 2 (1900) 555-6 p.p.; Bailey, Comp. Cat. Qld. Pl. (1913) 174 p.p.; Merrill & Perry, J. Arn. Arb. 23 (1942) 407-8; Specht & Mountford, Rec. Arnhem Land Exp. 3 (1958) 273 p.p.; v.d. Meijden & Caspers, Fl. Males. 7 (1971) 244 p.p.

Haloragis yarrabensis Domin, Bibl. Bot. 89 (1929) 1034 [Typus: "Nordost-Queensland: Savannenwälder auf den Hügeln bei Yarraba zwischen 300-500 m, besonders in den *Casuarina* — Beständen in Gesellschaft von *Helichrysum rupicola* (Domin I. 1910)". Holotypus: *K. Domin 7417*, -.i.1910, Queensland: distr. Yarraba: in tropodrymo/Ass. Casuarina et Helichrysum rupicola / in collibus, cca 300-500 m.s.m., PR530026 (fl., fr.)!]

Haloragis palauensis Tuyama, J. Jap. Bot. 16 (1940) 283-4 [Typus: "Micronesia, Caroline, Palau; Ins. Baobeltaob, sine loco speciali, leg. G. Koidzumu, Feb. 1915 — typus in Herb. Univ. Imp. Tokyo". Holotypus: n.v. Isotypus: *G. Koidzumu s.n.*, -.ii.1915, Palau, Isl. Babeltaob, TI (fl., fr.)!]

FIG.: Brongn., in Duperrey, Voy. Coq. Bot. (1828) t. 70; Tuyama, J. Jap. Bot. 14 (1940) 283, fig. 5.

Erect or ascending herb 30-45 (-100) cm tall, stems brown, slender, 4-angled or weakly 4-ribbed, scabrous with spreading simple, whitish, 3-4-celled hairs 0.2-0.7 mm long, older stems becoming glabrous.

Leaves decussate, on petioles 2-3 mm long, (narrow-) ovate, (1.5-) 2.5-3.0 (-5.0) cm long, 0.7-1.5 cm wide, rounded at base, obtuse and mucronate at tip, midrib sunken above, prominent below, lateral veins obscure, margin thickened, serrate with 16-20 (-45) obliquely cuspidate teeth 1-2 mm long, sparsely semi-appressed pubescent on both surfaces with hairs as for stems, or sometimes upper surface glabrous.

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Lateral inflorescences arise in axils of upper leaves, and these inflorescences may also bear lateral branches. Primary bracts leaflike, ± sessile, lanceolate, 1.5-2.7 mm long, 0.4-0.9 mm wide, entire or 1-2-toothed, caducous. Secondary bracts (bracteoles) membranous, ovate, 0.3 mm long, 0.2-0.3 mm wide, entire, or sometimes serrulate at apex, caducous.

Flowers 4-merous, on pedicels 0.1-0.3 mm long (Fig. 277). Sepals 4, red-green, oblong, 0.8-1.1 mm long, 0.5-0.6 mm wide, smooth, convex, glabrous. Petals 4, dark red, hooded, weakly keeled, non-unguiculate, 2.3-2.6 mm long, 0.5 mm wide (keel to margin), glabrous or sparsely scabrous on keel. Stamens 8, filaments 0.1-0.2 mm long; anthers red to yellow, linear-oblong, 1.8-2.1 mm long, 0.3 mm wide, 4-locular, nonapiculate, antisepalous anthers ca 0.3 mm longer than antipetalous ones. Styles 4, clavate, 0.3 mm long, stigmas bright red, capitate, fimbriate. Ovary red-grey, ovoid, 1.0 mm long, 0.8-0.9 mm wide, ± weakly 8-ribbed, with 3-4 conical calluses between ribs, glabrous except for collar of very short ± appressed stiff hairs at apex, just below sepals; incompletely 4-locular, 1 ovule per locule.

Fruit on pedicel 0.3-0.5 mm long, ovoid to cylindrical, 1.0-1.4 mm long, 0.9-1.0 mm wide, weakly 8-ribbed, with 3-4 conical calluses between ribs, glabrous except for collar of stiff ± appressed hairs just below sepals; sepals persistent, erect, oblong, 0.8-1.1 mm long, 0.5-0.6 mm wide, with styles reflexed between; pericarp membranous, 1 seed (Fig. 278).

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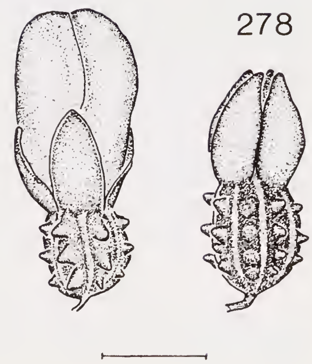
277 278



Figs. 276-278. *Gonocarpus acanthocarpus.* 276. Distribution. 277. Flower. 278. Fruit. (figs. 277, 278 from *Brass 18739*). Scale represents 1 mm (figs. 277, 278).

Distribution: *G. acanthocarpus* extends from eastern and northern Queensland to the lowlands of Papua New Guinea, West Irian and the Caroline Islands. In Queensland it can be found from sea level to an altitude of about 1000 m., but elsewhere has only been collected at low altitudes (Fig. 276).

Ecology: Although found in a wide range of habitats, from shallow rocky soils to rainforest, *G. acanthocarpus* usually favours damp situations and heavy soils. Collectors' notes include "Creek banks near rainforest" (*Ashby 791*); "sandy soil along new road, cleared swamp forest" (*Blake 19746*); "open rock slopes in and around living or dead *Micrairia* mats" (*Blake 21759*); "poorly drained savannah-forest; commonly surrounding termite mounds" (*Brass 8669*); "shrub ca 1 m high, scrambling in boggy ground between coastal sand dunes" (*Brass 18739*); "common locally on messmate savannah forests of sandy ridges" (*Brass 19168*); "frequent in a sedge and pitcher plant bog" (*Brass 19620*); "on bare hard ground in open forest of rocky ridges at about 3000 ft [1000 m] (*Brass 33612*); "near creek banks, close to edge of rain forest" (*Carr 132*); "lower slope of grassy hill" (*Henty NGF27044*); "in scrub country near the creek; shallow grey soil with clay subsoil" (*Jenkins BRI008813*); "in shallow rocky soil with *Eucalyptus citriodora* and *E. triandra*" (*Pedley 2302*); "very common along a small gully in the hills" (*Smith T186*); "moist field, mixed with grass" (*Takamatsu 1709a*). A note on the collection by Jenkins (BRI008813) states "owners lost 9 cattle in one week and suspect this plant". Plants with flowers and fruits have been collected throughout the year, although the main flowering and fruiting period is probably from about January to July.

Specimens examined:

CAROLINE ISLANDS: Kanehira 203, 6.vii.1929, Corol Island, Palau Is., NY (fr.); *Kanehira 423,* 17.vii.1929, Marikyoku, Maiin Island, NY (fl.); *Kanehira & Hatusima 4543,* -.iv.1938, Amiriik, Palau, GH (fl., fr.); *Koidzumu s.n.,* -.ii.1915, Palau Is., Babeltaob, TI (fl., fr.) — isotype of *H. palauensis*; *Takamatsu 1709a,*

12.iv.1936, Marukiyoku, BISH (fl., fr.); *Tuyama s.n.*, 25.viii.1937, Baberudaobu, Aimiriik, TI (fl.); *Tuyama s.n.*, 2.ix.1939, Ins. Baobeltaob, Ngarathmao, in monte Ngeleeleuus, TI (fr.). *PAPUA NEW GUINEA: Brass 8669*, -.i.1937, Tarara Wassi Kussa River, A, BRI (fr.); *Henty NGF27044*, 6.xi.1965, Abilete, Rossel Island, BRI (st.); *WEST IRIAN: Aet 647*, 13.viii.1941, Babo, McCluer Gulf, A (fl.); *d'Urville s.n.*, Offak (Waigiou), P (fr.) (photo only) — type of *H. acanthocarpus*. *QUEENSLAND: Ashby 791*, -.iii.1941, Mt. Windsor, AD (fl.); *Bailey s.n.*, 1873, Cardwell, BRI079963 (fl., fr.); *Bancroft 123, 164*, -.vi.1900, Stannary Hills, BRI (fl., fr.); *Betche s.n.*, -.viii.1901, Atherton, NSW103126 (fr.); *Blake 19746*, 14.xi.1954, near Daintree, BRI (fl., fr.); *Blake 21759*, 19.v.1962, Walsh's Pyramid, AD, BRI (fl., fr.); *Brass 1761*, -.ii.1928, Newcastle Range, between Forsayth and Einasleigh, BRI, CANB (fl., fr.); *Brass 18739*, 10.v.1948, Newcastle Bay, 2½ miles [4 km] S. of Somerset, CANB (fl., fr.); *Brass 18911*, 21.v.1948, Jardine River, CANB (fl., fr.); *Brass 19168*, 13.vi.1948, Brown's Creek, Pascoe River, BRI, CANB (fl., fr.); *Brass 19357*, 29.i.1948, Tozer Range, north end, BRI, CANB (fl., fr.); *Brass 19419*, 3.vii.1948, Tozer Gap, Tozer Range, BRI, CANB (fl., fr.); *Brass 19571*, 14.vii.1948, Brown's Creek, Pascoe River, BRI, CANB (fl., fr.); *Brass 19620*, 16.vii.1948, Brown's Creek, Pascoe River, BRI, CANB (fr.); *Brass 33553*, 4.vi.1967, Davies Creek, Lamb Range, CAIRNS (fl., fr.)); *Brass 33612*, 29.vii.1967, between Herberton and Watsonville, BRI, CAIRNS (fr.); *Brass & White 271*, 22.ix.1937, foothills of Thornton Peak, BRI, CANB (fl., fr.); *Carr 132*, 25.iii.1941 - 1.iv.1941, Mount Windsor, CAIRNS (fl.); *Dallachy s.n.*, Rockingham Bay, MEL1003425-7 (fl.); *Domin 7417*, -.i.1910, Yarraba, PR (fl., fr.) — holotype of *H. yarrabensis*; *Fielding s.n.*, -.xii.1947, Tully Falls, 80 miles [128 km] S. Cairns, NSW99292 (st.); *Fitzalan s.n.*, 1882, Trinity Bay, MEL1003431 (fl., fr.); *Flecker 436*, 21.iv.1935, Mt. Mulligan, BRI, CAIRNS (fr.); *Flecker 1545, 1546*, 12.iv.1936, Bessies Creek, CAIRNS (fl.); *Jenkins s.n.*, 28.iv.1958, Devil Devil Creek, Rumula, BRI008813 (fl.); *Johnson s.n.*, 1891, Barron River, MEL1003747 (fl., fr.); *Johnson s.n.*, 1891, Mt. Bellenden Ker Range, AD97224144, MEL1003708 (fl.); *McKee 9135*, 17.iv.1962, Boyle Creek, CANB, NSW (fl., fr.); *McKee 9324*, 25.iv.1962, Davies Creek (Mareeba District), CANB, NSW (fl.); *Michael 436*, -.vii.1918, Yarrabah, BRI (fl.); *Pedley 2302*, 25.iv.1967, Herberton, BRI (fl., fr.); *Smith T186*, 19.x.1942, near Abswold, BRI (st.); *Walter s.n.*, 1871, Fitzroy Isl., MEL1003718 (fl.).

As in several other species of *Gonocarpus*, *G. acanthocarpus* shows the phenomenon of male sterility (abortive anthers and petals) on occasional plants. Examples in this case are the collections *Kanehira 423* and *Blake 21759*.

G. acanthocarpus is most closely allied to *G. leptothecus*, differing mainly in the size and sculpturing of the fruits (see *G. leptothecus* for details). The collar of minute stiff hairs at the top of the ovary in *G. acanthocarpus*, a good diagnostic feature in most collections, is absent from *Brass 18739* and *Brass & White 271*.

The type of *Haloragis acanthocarpa* was not available for loan, but was kindly examined on my behalf by J. Jeremie. The specimen was collected at Fofak Baai, Waigeo Island, probably during September 1823, while the *Coquille* was at anchor there.

20. **Gonocarpus leptothecus** (F. v. M.) Orchard (Figs. 279, 280)

Gonocarpus leptothecus (F. v. M.) Orchard, comb. nov.

Haloragis leptotheca F. v. Mueller, Fragm. 3 (1862) 32 [Typus: "Ad flumen Victoriae ostium versus in campis virgultosis aridioribus". Holotypus: *Dr. Mueller s.n.*, Oct. 1855, May 1856, Victoria River near the Main Camp, MEL1003433 (fr.)!; Isotypus: *Anon. s.n.*, May 1856, Victoria River near the Main Camp, MEL1003794 (fl., fr.)!] F. v. M., Census 1 (1882) 50; F. v. M., Trans. Proc. R. Soc. Vict. 24 (1888) 134; F. v. M., Sec. Census 1 (1889) 86.

Haloragis veronicifolia Schindl., Pflrch 23 (1905) 35-36 [Typus: "Australien: Neu-Süd-Wales, ohne Standortsangabe (Ferd. Bauer). — Hb. Berlin, Wien." Lectotypus (Orchard): *Ferd. Bauer s.n.*, Nov. Holland ora austral., W (fl.)!; Syntypus: *Ferd Bauer s.n.*, Nov. Holland. W (st.)!] Maiden & Betche, Cens. N.S. Wales Pl. (1916) 158.

Haloragis acanthocarpa auct. non Brongn.: Benth., Fl. Aust. 2 (1864) 483; Bailey, Qld. Fl. 2 (1900) 555 p.p.; Bailey, Comp. Cat. Qld. Pl. (1913) 174 p.p.; Ewart & Davies, Fl. N.T. (1917) 214; Fitzgerald, Bot. Kimberleys N.W. Aust. (1918) 90; Gardner, Enum. (1931) 99; Specht & Mountford, Rec. Arnhem Land Exp. 3 (1958) 273 p.p.

Annual herb or subshrub, 45-60 cm tall, up to 60 cm diam., stems erect, ± 4-ribbed, spreading pubescent with simple 1-4-celled transparent hairs 0.2-1.0 mm long. Leaves decussate, internodes 2.5-3.5 cm, shortly petiolate (petioles 1-3 mm long), lamina oblong to elliptic, 2.5-3.0 (-5.0) cm long, 1.0-1.5 cm wide, widest towards middle, base rounded, apex rapidly tapered to point, mid-green both faces, midrib channelled above, prominent below, margin serrate with 25-30 obliquely cuspidate teeth, lamina moderately densely pilose on both faces with semi-appressed hairs as for stems.

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Numerous lateral inflorescences in axils of upper leaves. Primary bracts green, leaf-like, lanceolate to narrow-ovate, 3.0-3.5 mm long, 0.7-1.5 mm wide, margins entire or 3-5-dentate, scabrous with short ± appressed hairs. Secondary bracts brown, membranous, linear to lanceolate, 0.7-1.0 mm long, 0.3-0.4 mm wide, margin ca 5-denticulate.

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Figs. 279, 280. *Gonocarpus leptothecus*. 279. Distribution. 280. Fruit (from *Chippendale s.n.*, NT6041). Scale represents 1 mm.

Flowers 4-merous, on pedicels 0.6-0.8 mm long. Sepals 4, oblong to deltoid, 0.6-0.9 mm long, 0.3-0.6 mm wide, convex, glabrous. Petals 4, green to red, hooded, keeled, very shortly unguiculate, 2.3-3.4 mm long, 0.5-0.7 mm wide (keel to margin), with 2-3 rows of stiff hairs along keel. Stamens 8, filaments 0.1-0.2 mm long; anthers red, linear-oblong, 2.2-2.7 mm long, 0.3 mm wide, 4-celled, non-apiculate. Styles 4, clavate, 0.2 mm long, becoming reflexed between sepals after anthesis, stigmas cream, fimbriate. Ovary cylindrical, 1.4-2.0 mm long, 0.7-0.9 (-1.7) mm wide, 8-ribbed with 3-5 angular tubercles between ribs, incompletely 4-locular, 1 ovule per locule.

Fruit on pedicel 0.7 mm long, cylindrical, 1.8-2.0 mm long, 0.8-0.9 mm wide, 8-ribbed, with 3-5 angular tubercles between ribs, glabrous; sepals persistent, erect, ovate to deltoid, 0.9 mm long, 0.6 mm wide, convex, glabrous; 1 seed (Fig. 280).

Distribution: *G. leptothecus* has been collected from Settlement Creek in the extreme north-west of Queensland to the King Sound/King Leopold Range area of northern Western Australia (Fig. 279).

Ecology: This species is confined almost entirely to open situations on sandy or sandstone soils. Collectors' notes include: "savannah woodland on sands" (*Carolin 6751*); "occasional on gentle granite slopes with *Eucalyptus* spp., annual *Sorghum* sp., and forbs" (*Lazarides 7102*); "locally common in deep yellow sand on gentle slopes, with *Eucalyptus tetradenta, Acacia* spp. and *Sorghum intrans*" (*Lazarides & Adams 195*); "in *Acacia* scrub on sandy soil" (*Specht 211*); "in *Eucalyptus alba* — *E. polycarpa* woodland at foot of sandstone hills" (*Specht 509*); "occasional at edge of *Melaleuca leucodendron* stand" (*Specht 959*); "rocky gully and pool" (*Symon 6961*); "quartzite outcrop" (*Symon 7122*). The main flowering season is from March until June, with occasionally a secondary flowering in August. Fruits are present from March until July.

SPECIMENS EXAMINED:

WESTERN AUSTRALIA: Basedow s.n., 1916, Glenelg River District, between King Is. and Exmouth Gulf, NSW103120 (fr.); *Hughan s.n.,* 1869, King's Sound, MEL1003432 (st.); *Langfield 380,* Ivanhoe Station, East Kimberleys, CANB, PERTH (fl., fr.); *Fitzgerald 787,* -.v.1905, Mount Herbert, King Leopold Ranges, PERTH (fr.); *Fitzgerald 907,* -.v.1905, Isdell River near Graces Knob, PERTH (fl., fr.); *Symon 6961,* 22.v.1971, Middle Springs, Deception Range, just out of Kununuma, AD, ADW (fr.); *Symon 7088,* 28.v.1971, 6 miles [9.5 km] north of Drysdale Station, AD, ADW (fr.); *Symon 7122,* 29.v.1971, between Kalumburu Mission and Longini Landing, AD, ADW (fr.). *NORTHERN TERRITORY· Byrnes 768,* 13.v.1968, Jasper Gorge, AD, NT (fl., fr.); *Byrnes 790,* 16.v.1968, Pine Creek, Oenpelli Road, 4 miles [6.5 km] east of Mary River, AD (fl., fr.); *Byrnes 1524,* 2.iv.1969, Waterfall Creek, South Alligator River, NT (fl., fr.); *Carolin 6751,* 14.v.1968, ca 5 miles [8 km] east of Mary River on Oenpelli to Pine Creek road, AD (fl., fr.); *Chippendale s.n.,* 10.v.1959, 10.7 miles [17 km] west Timber Creek Police Station, AD97049276. NT6041 (fl., fr.); *Chippendale s.n.,* 15.iii.1961, 21.5 miles [34.5 km] S.E. of Pine Creek, BRI043093, NSW99289, NT7562 (fl.); *Forrest s.n.,* 1879, Lat. 16°15′, Long. 131°30′, MEL1003424 (fr.); *Lazarides 7102,* 25.iii.1964, on Stuart Highway, 20 miles [32km] S.E. of Pine Creek, CANB, NSW, NT (fl.); *Lazarides & Adams 195,* 12.iii.1965, c. 36 miles [56 km] N.E. of Pine Creek township, CANB, NT (fl.); *Mueller s.n.,* -.x.1855 & -.v.1856, Victoria River, MEL1003433, 1003794 (fl., fr.) — type of *Haloragis leptotheca*; *Perry 1765,* 26.vii.1948, 20 miles [32 km] W. of Borroloola Station, CANB, MEL, NT, PERTH (fr.); *Specht 211,* 10.iv.1948, Little Lagoon, Groote Eylandt, AD, BRI, CANB, MEL, PERTH (fl., fr.); *Specht 509,* 9.vi.1948, South Bay, Bickerton Island, AD, BRI, CANB, MEL, NSW (fl., fr.); *Specht 959,* 22.viii.1948, Gove, AD, BRI, CANB, MEL (fl.); *Symon 7712,* 15.vi.1972, 29 km N.E. of the turnoff to Maningrida on the road to Gove, ADW (st.); *Symon 7736,* 17.vi.1972, 8 km N.E. of the Goyder River crossing at 12°51′, 135°02′, ADW (fr.). *QUEENSLAND: Brass 142,* -.iv.1922, Settlement Creek, BRI, CANB (fl., fr.). *LOCALITY UNCERTAIN: Armit 627,* Yeldham Creek, Herberts River, MEL (fr.) (2 sheets); *Bauer s.n.,* Nov. Holland., W (fl.) — type of *Haloragis veronicifolia*; *Brown s.n.,* 1802, North Coast (Flinders Expedition), MEL1003428 (fl.).

It was necessary to choose a lectotype for *Haloragis veronicifolia* as there are three Bauer specimens in W that agree with Schindler's citation. The specimen chosen is the only fertile one, and bears Schindler's determination. Of the other two specimens, one has Schindler's determination "Halorrhagis veronicifolia Schindler nov. spec." but is, in fact, *Gonocarpus chinensis* subsp. *verrucosus*. The third sheet is a sterile specimen of *Gonocarpus leptothecus*, annotated "? Haloragis ? n. sp. ? nimis incompleta" by Schindler.

Bentham (1864) reduced *Haloragis leptotheca* to synonomy under *H. acanthocarpa,* and in this has been followed by most subsequent authors. However, the two species are easily distinguished by their fruits; those of *G. leptothecus* being longer (1.8-2.0 mm, excluding calyx) with angular tubercles between the ribs, those of *G. acanthocarpus* shorter (1.0-1.4 mm long) with conical tubercles between the ribs (Figs. 278, 280). There are also ecological differences: *G. leptothecus* is found almost exclusively on sand or sandstone soils while *G. acanthocarpus* prefers heavier, more poorly drained soils.

21. **Gonocarpus benthamii** Orchard (Figs. 281-286)

Gonocarpus benthamii Orchard, nom. nov.

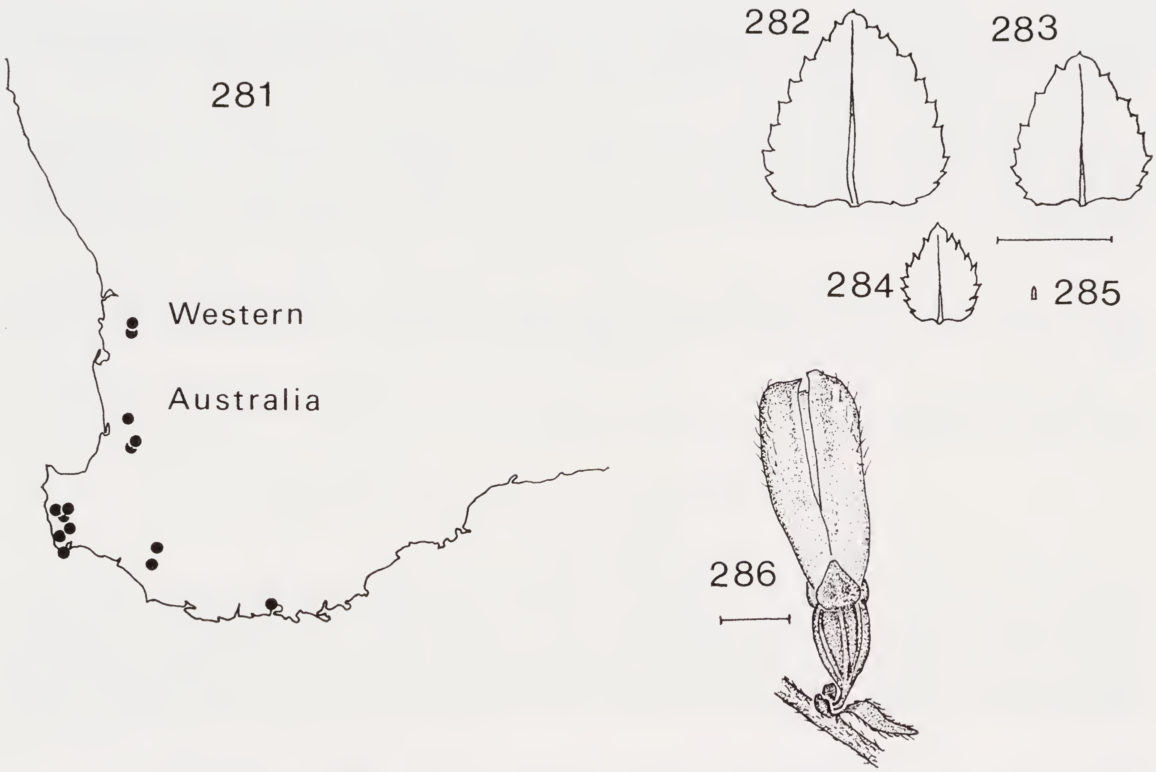
Haloragis rotundifolia Benth., Fl. Aust. 2 (1864) 480, non *Goniocarpus rotundifolius* Drake (?) in Rees, Cyclop. 16 (1811), non *G. rotundifolius* F. v. M. ex Hook. f., Fl. Tasm. 1 (1856) 121, nom. illeg. [Typus: "W. Australia, Swan River, Drummond, 1st Coll.; Flinders Bay, Collie." n.v.]; F. v. M., Fragm. 8 (1874) 162; F. v. M., Census 1 (1882) 49; F. v. M., Trans. R. Soc. Vict. 24 (1888) 134; F. v. M., Sec. Census 1 (1889) 85; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 30; Diels & Pritzel, Bot. Jb. 35 (1904) 447; Schindler, Pflrch 23 (1905) 41; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 466; Praglowski, Grana 10 (1970) 172.

FIGS.: Schindler, Pflrch 23 (1905) fig. 11N; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 466.

Erect or ascending herb or subshrub 25-70 cm tall, stems red-brown, not ribbed or angled, branching mainly at base, densely scabrous with spreading, simple, uniseriate, 2-4-celled hairs 0.1-0.5 mm long.

Leaves decussate, sessile or very shortly petiolate, ovate to orbicular, 0.7-1.7 cm long, 0.7-1.5 cm wide, subcordate at base, acute or obtuse at apex, serrate with (8-) 10-14 (-16) obliquely cuspidate or subdeltoid teeth 0.15-0.2 mm long, margin not or only slightly thickened, midrib obscure above, prominent below, lateral veins indistinct, upper surface dark green, lower surface paler, scabrous on both faces, the hairs in older leaves seated on a small tubercle (Figs. 282-284).

Inflorescence an indeterminate spike of flowers borne singly in the axils of alternate primary bracts (Figs. 285, 286). Several upper leaves subtend lateral inflorescences and these in turn may bear laterals. Primary bracts green, fleshy, linear, 1.3-2.0 mm long, 0.4-0.6 mm wide, entire, lacking midrib, scabrous with hairs as for stem. Secondary bracts brown, membranous, ovate-oblong, (0.2-) 0.3-0.4 mm long, 0.2 mm wide, faint midrib, very weakly serrulate in upper part, glabrous.



Figs. 281-286. *Gonocarpus benthamii.* 281. Distribution. 282-284. Leaves. 285. Primary bract. 286. Flower with primary and secondary bracts. (figs. 282-286 from *Koch 2260*). Scale represents 1 cm (figs. 282-285) or 1 mm (fig. 286).

Flowers 4-merous, on pedicels 0.2-0.4 mm long. Sepals 4, red-green, ovate, (0.4-) 0.5-0.7 mm long, 0.5-0.6 mm wide, saccate at base, with a median and two lateral basal calluses, no midrib, glabrous. Petals dark red, hooded, keeled, nonunguiculate, 2.2-2.7 mm long, 0.6 mm wide (keel to margin), scabrous on keel. Stamens 8, filaments 0.1-0.2 mm long; anthers yellow to red, linear-oblong, 1.7-2.1 mm long, 0.3 mm wide, antipetalous anthers ca 0.3 mm shorter than antisepalous ones, 4-celled, nonapiculate. Styles 4, bulbous, 0.3-0.4 mm long; stigmas red, capitate, fimbriate. Ovary purplish, obovoid, 1.0-1.2 mm long, 0.7-0.9 mm wide, tapering gradually to base, 8-ribbed or almost smooth, semi-appressed scabrous, incompletely 4-locular, 1 ovule per locule.

Fruit on pedicel 0.4-0.5 mm long, grey to purplish, obovoid, 0.9-1.0 mm long, 0.7-0.8 mm wide, weakly 8-ribbed, scabrous; sepals persistent, erect, enclosing styles, 0.5-0.6 mm long, 0.5 mm wide, glabrous; pericarp membranous, 1 locule, 1 seed.

Distribution: *G. benthamii* is confined to the south-western part of Western Australia, in a more or less coastal strip running from Perth to Albany (Fig. 281).

Ecology: This species has been found in a diverse series of habitats. Collectors' notes include "Karri-marri-jarrah association, dense undergrowth" (*Aplin 1368*); "Ironstone hills" (*Gardner*); "on brooks and cataracts" (*Mueller MEL39246*); "forest rivulets" (*Mueller MEL39244, 39247*); "gravel soil" (*Royce 100*); "exposed windy, many plants prostrate" (*Wrigley*). Flowering occurs from October to February, and fruiting from December until March.

Specimens examined:

WESTERN AUSTRALIA: Anon. s.n., Serpentine River, MEL39243 (fl.); *Aplin 1368,* 11.xii.1961, 1 m. [2 km] south of Manjimup, PERTH (fl.) — voucher for Alkaloid Survey; *Aplin 27816,* 31.x.1963, Denmark, PERTH (fl.); *Bennett 2837,* 26 miles [40 km] from Augusta on Nannup road, PERTH (fl.); *Diels & Pritzel 190, 200,* 1.i.1901, Wellington, Distr.: Lunenberg, PERTH (fr.); *Fitzgerald s.n.,* -.i.1900, Darling Range, AD96921180 (fr.); *Gardner s.n.,* -.xii.1936, Margaret River, PERTH (st.); *Koch 2260,* -.xii.1916, Big Brook, Pemberton, AD, BRI, MEL (2) (fl., fr.); *Jackson s.n.,* -.xi.1912, Bow River, NSW103157 (fl.); *Morrison s.n.,* 11.ii.1899, Green's Siding, Canning Jarrah Railway, BRI080089, CANB136626, PERTH (fl., fr.); *Mueller s.n.,* 1.xii.1877, Serpentine River, MEL39246 (fl.); *Mueller s.n.,* 7.xii.1877, Collie's & Preston's River, MEL39244 (fr.); *Mueller*

s.n., 8.xii.1877, Preston's River, MEL39247 (fl.); *Royce 100,* 19.i.1945, Nillup, S.E. of Margaret River, PERTH (fl., fr.) — pollen sent to Palyn. Lab. Stockholm; *Royce 1399,* 7.xi.1946, Rosa Brook, Margaret River District, PERTH (fl.); *Stokes s.n.,* 10.iii.1955, Gidgigannup, PERTH (fr.); *Walcott s.n.,* Karri Dale, MEL39248 (fl.); *Wrigley s.n.,* 16.x.1968, Cape Leeuwin, AD97015056, CBG029953 (fl.).

The combination *G. rotundifolius* is not available when *H. rotundifolia* is transferred to *Gonocarpus,* because of the prior use of this name in Rees Cyclopaedia (1811). The author of *G. rotundifolius* is not clear, but may have been the Rev. W. F. Drake (see Stafleu, 1967). The type of *G. rotundifolius* Drake has not been located, but from the description it seems to be identical with *G. micranthus* subsp. *ramosissimus* Orchard.

No type material of *Haloragis rotundifolia* was available for study. However the Gardner collection cited above bears a label "Matched: Swan River, Drummond s.n., Flinders Bay, N.H., Collie, Herb. Hook." in the handwriting of C. A. Gardner.

The relationships of *G. benthamii* are with *G. intricatus,* from which it can be distinguished by its longer fruit, 2-4-celled hairs and non-cordate sepals.

22. **Gonocarpus intricatus** (Benth.) Orchard (Fig. 287)

Gonocarpus intricatus (Benth.) Orchard, comb. nov.

Haloragis intricata Bentham, Fl. Aust. 2 (1864) 481 [Typus: "W. Australia, Drummond, 5th Coll. n. 39." Holotypus: n.v. Isotypi: *Drummond 39,* 1850, Swan River, G (herb. Boiss.) (fl.)!; *Drummond V. 39,* 1848, De Swan River au Cap Riche, G (herb. Deless.) (fl., fr.)!; *J. Drummond V. 39,* Australia ad fl. Cygnorum, LE (fl.)!; *J. Dr. 39,* W.A., MEL39140, 39141 (fl.)!; *Drummond ser. 5 suppl. no. 39,* Swan R., W1953, fl.)!]; F. v. M., Census 1 (1882) 49; F. v. M., Sec. Census 1 (1889) 85; Schindler, Bot. Jb. 34 Beibl. 77 (1904) 30; Schindler, Pflrch 23 (1905) 39-40; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 467; Praglowski, Grana 10 (1970) 172.

FIGS.: Schindler, Pflrch 23 (1905) fig. 11G; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 467.

Erect perennial (?) herb 17-30 cm tall, stems red to green, strongly 4-ribbed, branching mainly at base, sparsely pilose with strongly appressed, white to transparent, simple, uniseriate, 1-2-celled (if 2-celled then cell at tip very short) hairs 0.4-0.7 mm long.

Leaves decussate (becoming alternate near inflorescence), ovate to narrow-ovate, 1.0-1.3 cm long, 0.5-1.0 cm wide, sessile, coarsely serrate with (6-) 8-12 obliquely deltoid teeth 1-2 mm long, margin very slightly thickened, midrib channelled above, prominent below, lateral veins obscure, ± glabrous on upper face, sparsely pilose on midrib below with hairs as for stems.

Inflorescence an indeterminate spike of flowers borne singly in the axils of alternate primary bracts. Lateral inflorescences arise in the axils of the reduced upper leaves. Major axis of inflorescence flexuose, and tips drooping (as in *G. elatus*). Primary bracts green, fleshy, linear-lanceolate, 1.5-2.2 mm long, 0.4-0.5 mm wide, entire, glabrous. Secondary bracts brown, membranous, ovate, 0.4-0.6 (-0.9) mm long, 0.3-0.4 mm wide, toothed, glabrous.

Flowers 4-merous, on drooping pedicels 0.5-0.7 mm long. Sepals 4, green, cordate, 0.5-0.6 mm long, 0.5-0.8 mm wide, acute at tip, margins slightly thickened, lacking midrib, attached to torus for entire width, glabrous. Petals 4, yellowish-red, keeled, hooded, shortly unguiculate, 1.4-1.6 mm long, (0.4-) 0.5-0.6 mm wide, sparsely scabrous on keel. Stamens 8, filaments 0.1-0.2 mm long; anthers yellow, linear-oblong, 1.1-1.2 mm long, 0.25-0.3 mm wide, all equisized, 4-celled, nonapiculate. Styles 4, clavate, 0.3 mm long, stigmas capitate. Ovary dark red-purple, obovoid, 0.6-0.7 mm long, 0.6-0.7 mm wide, 8-ribbed, otherwise smooth, semi-appressed scabrous on ribs, septa ± absent, 4 ovules.

Fruit on pedicel 0.5-0.7 mm long, silvery-grey to purplish, obovoid to oblong, 0.7 mm long, 0.7 mm wide, 8-ribbed, otherwise smooth, sparsely appressed scabrous on ribs; sepals persistent, erect, cordate, 0.5 mm long, 0.5 mm wide, enclosing styles, glabrous; 1 locule, 1 seed, pericarp membranous.

DISTRIBUTION: *G. intricatus* is confined to south-western Western Australia. The only particular locality mentioned is Kellerberrin (Fig. 287).

ECOLOGY: Flowering and fruiting are both noted for November.

SPECIMENS EXAMINED:

WESTERN AUSTRALIA: Drummond V. 39, 1848-50, Swan River, G (herb. Boiss., herb. Deless.), LE, MEL, W (fl., fr.) — isotypes of *Haloragis intricata*; *Fitzgerald s.n.,* -.xi.1907, Kellerberrin, NSW99113, 99114 (fl., fr.).

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Fig. 287. Distribution of *Gonocarpus intricatus.*

Of the various type specimens examined, none could reasonably be considered to represent the holotype. There was no type material of this species amongst the Kew specimens examined, and neither of the two MEL types had the circumscription "5th collection" cited by Bentham, nor did they have any indication that he had examined them.

The relationships of *G. intricatus* seem to be with *G. benthamii* and *G. diffusus*. From *G. diffusus*, *G. intricatus* can be distinguished by its strongly cordate sepals, scabrous indumentum and shorter fruit, while from *G. benthamii* it can be distinguished by its shorter fruit, 1 (-2)-celled (rather than 2-4-celled) hairs, and cordate sepals.

23. **Gonocarpus diffusus** (Diels) Orchard (Figs. 288-291)

Gonocarpus diffusus (Diels) Orchard, comb. nov.

Haloragis diffusa Diels, in Diels & Pritzel, Bot. Jb. 35 (1904) 447, nec Cockayne 1909 [Typus: "Hab. ad fretum King George Sound pr. Albany in arenosis humosis madidis flor. m. Nov. (D.5564)". Holotypus: B, n.v. (probably destroyed). Isotypi: *Diels 5564*, 17.xi.1901, West Australien: S. Plantagenet: Albany, MEL38940 ex B (fl.)!; *Diels 5564*, West Australien, NSW113150 (fl.)!]; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 30, 38, 49; Schindler, Pflrch 23 (1905) 40; Britten, J. Bot. 45 (1907) 136; Cheeseman, Trans. N.Z. Inst. 42 (1909) 202; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 468.

Gonocarpus ('*Goniocarpus*') *tetragynus* auct. non Labill.: Nees in Lehm., Pl. Preiss. 1 (1844) 158.

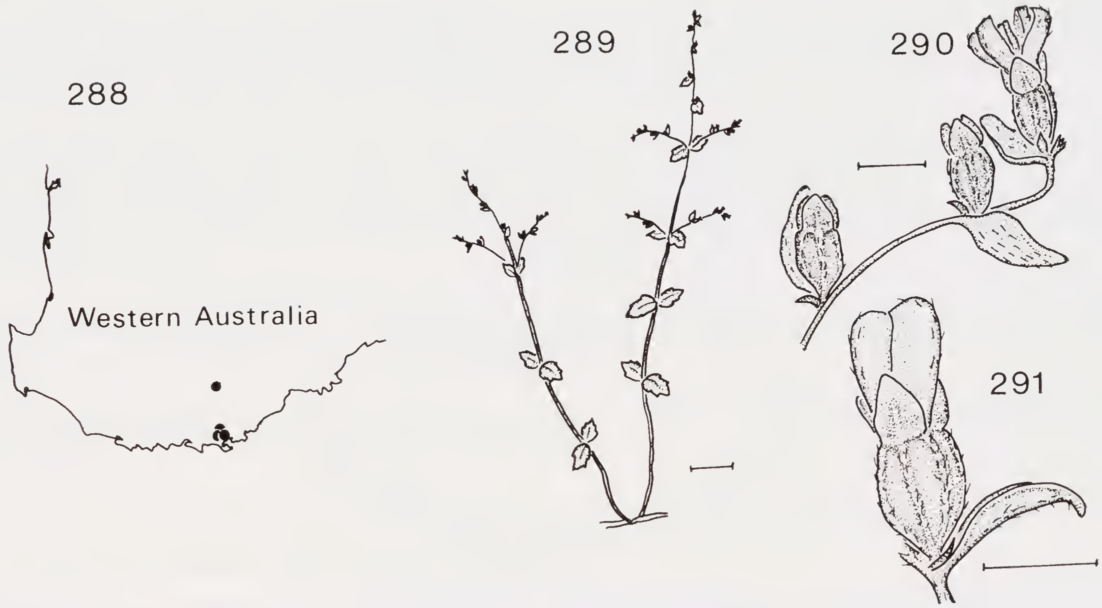
Haloragis teucrioides auct. non (DC.) Schindl.: Benth., Fl. Aust. 2 (1864) 484, p.p.

Figs.: Schindler, Pflrch 23 (1905) fig. 11K-M; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 468.

Slender ascending or procumbent herb 17-40 cm tall, stems green, weakly 4-ribbed or almost smooth, rooting at nodes in lower part, glabrous (sometimes sparsely appressed pilose on tips of very young stems (Fig. 289).

Leaves decussate, ovate, 0.6-1.0 cm long, 0.7-0.8 cm wide, reduced towards inflorescence, on petiole 0.5-1.0 mm long, apex acute, base rounded or subcordate, margins thickened, serrate with (2-) 4-6 obliquely cuspidate teeth 0.5-1.0 mm long, midrib obscure above, prominent below, lateral veins obscure, glabrous or sparsely appressed pubescent on both surfaces and petiole with simple, transparent, unicellular hairs 0.2-0.3 mm long.

Inflorescence an indeterminate spike of flowers borne singly in the axils of alternate primary bracts. Lateral inflorescences arise in the axils of the upper leaves. Primary bracts ovate, 1.8-2.5 mm long, 0.8-1.4 mm wide, green, ± sessile, margins thickened, entire, apex acute, base rounded, midrib absent, glabrous. Secondary bracts (bracteoles) brown, membranous, ovate, 0.4 mm long, 0.2-0.3 mm wide, ± entire (Figs. 290, 291).



Figs. 288-291. *Gonocarpus diffusus*. 288. Distribution. 289. Habit. 290. Tip of inflorescence. 291. Flower with primary and secondary bracts. (figs. 289-291 from *Anon s.n.*, MEL39245). Scales represent 1 cm (fig. 289) or 1 mm (figs. 290, 291).

Flowers 4-merous, on pedicels 0.3-0.4 mm long. Sepals 4, green-grey, ovate-deltoid, 0.5-0.6 mm long, 0.4-0.5 mm wide, margin thickened, tip acute, base ± saccate, truncate or subcordate, no midrib or calluses, glabrous. Petals 4, reddish, hooded, keeled, 1.3-1.5 mm long, 0.4-0.5 mm wide, scabrous on keel. Stamens 8, filaments 0.1-0.2 mm long; anthers yellow, oblong, 0.7-0.8 mm long, 0.2 mm wide, 4-celled, nonapiculate, ± equal sized. Styles 4. Ovary silvery grey to whitish, ovoid to globular, 0.8-1.1 mm long, 0.7-0.8 mm wide, 8-ribbed, the ribs smooth or minutely tuberculate, glabrous.

Fruit shortly cylindrical, 0.8-1.1 mm long, 0.8-1.0 mm wide, 8-ribbed, the ribs smooth or minutely tuberculate, pericarp membranous, whitish or very light silver-grey; sepals green, persistent, erect, enclosing styles, oblong, 0.6-0.7 mm long, 0.4-0.5 mm wide, margin thickened, glabrous.

Distribution: *G. diffusus* is confined to south-western Western Australia, in the vicinities of Perth and Albany (Fig. 288).

Ecology: The only available notes on the habitat favoured by this species are those of *Preiss 2390* (LE) "in turfoso-arenosis scaturiginosis" and Diels (original description) "in arenosis humosis madidis". Flowering is recorded for November-December and fruiting for December.

Specimens examined:

WESTERN AUSTRALIA: Anon. s.n., 12.xii.1877, Karri forests, Shannon [River], MEL39245 (fl., fr.); *Diels 5564*, 17.xi.1901, Albany, MEL, NSW (fl.) — isotypes of *Haloragis diffusa*; *Drummond 85*, 1848, W. Australia, NSW (fr.); *Preiss 2087*, 1843, Princess Royal Harbour, G (herb. DC.), LE, MEL, NSW, P (fl., fr.); *Preiss 2390*, 8.xii.1840, Stirlings terrasse, Plantagenet, LE, MEL (fl., fr.); *Preiss 2390*, 1843, in Col. Swan River, G (herb. DC.) (fr.).

In most collections the ribs of the ovary and fruit are perfectly smooth, but in *Preiss 2087* (MEL) the ribs are minutely tuberculate. A duplicate of this atypical specimen must have formed the basis for Schindler's figure 11K (1905).

Diels described the bases of the sepals as broadly cordate, and cited this as one of the features distinguishing *G. diffusus* from *G. micranthus*. On close examination the sepals can be seen to be saccate at the base, and this swelling can be subcordate in some flowers, but is more usually truncate.

G. diffusus closely resembles *G. intricatus* but the latter can be distinguished by its strongly cordate sepals and scabrous indumentum on the stems, leaves and ovary, and by its shorter fruit.

The Preiss specimens (2087, 2390) cited by Nees (1840) under the name *Goniocarpus tetragynus* belong here. One of the same Preiss collections is mentioned by Bentham (1864) under *Haloragis teucrioides*.

24. **Gonocarpus rudis** (Benth.) Orchard (Figs. 292-294)

Gonocarpus rudis (Benth.) Orchard, comb. nov.

Haloragis rudis Bentham, Fl. Aust. 2 (1864) 480 [Typus: "W. Australia, Drummond, 4th Coll. n. 81." Holotypus: n.v. Isotypi: *J. Dr. s.n.*, W.A., MEL39253!, 39254! (st.); *J. Dr. 81*, W.A., MEL39255!, 39256! (fr.); *Drummond 4th coll., 81*, Swan River, CGE!, G (herb. Boiss. — 2 sheets)!, LE!, W! (st.)] F. v. M., Census 1 (1882) 49; F. v. M., Trans. R. Soc. Vict. 24 (1888) 135; F. v. M., Sec. Census 1 (1889) 85; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 40; Schindler, Pflrch 23 (1905) 41; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 466; Praglowski, Grana 10 (1970) 172.

Figs.: Schindler, Pflrch 23 (1905) fig. 11o; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 466; Praglowski, Grana 10 (1970) pl. 4 (e-g).

Erect annual (or perennial?) herb 15-30 cm tall, rootstock of numerous fibrous laterals spreading horizontally, stems red-brown, unribbed, freely branching above a short trunk, younger ones densely spreading pilose with simple uniseriate, 5-7-celled, hyaline hairs 0.5-1.5 mm long.

Leaves deep reddish olive, decussate, becoming alternate near inflorescence, sessile, oblanceolate, 0.8-1.0 cm long, (0.2-) 0.3-0.4 cm wide, margin thickened, whitish, serrulate with 6-8 teeth 0.2-0.3 mm long, midrib slightly prominent on lower surface, otherwise veins indistinct, densely pilose on both faces with hairs as for stems.

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Lateral inflorescences rare, in axils of upper leaves. Primary bracts leaflike, lanceolate, (2.2-) 3.0-4.0 mm long, (0.4-) 0.7-1.0 mm wide, ± entire, margin thickened, pilose on both faces. Secondary bracts red-brown, membranous, linear (-oblanceolate), 0.5-0.7 mm long, 0.2-0.3 mm wide, entire, tip recurved, glabrous (Fig. 294).

Flowers 4-merous, on pedicels 0.5-0.7 mm long (Figs. 293, 294). Sepals 4, green, ovate (-deltoid), 0.5-0.7 mm long, 0.5-0.7 mm wide, margin thickened, very weak median basal callus, glabrous. Petals 4, dark red, hooded, keeled, non-unguiculate, (1.4-) 2.1-2.2 mm long, 0.5-0.7 mm wide (keel to margin), pilose on keel. Stamens 8, filaments 0.1 mm long; anthers linear-oblong, 0.9-1.5 mm long, 0.2 mm wide, 4-celled, nonapiculate. Styles 4, clavate, 0.2 mm long, stigmas capitate. Ovary dark purple-grey, ovoid to globose, 0.8-0.9 mm long, 0.8 mm wide, weakly 8-ribbed, moderately densely appressed pilose with hairs 0.1-0.2 mm long, or glabrous; septa incomplete, 4-locular, 1 ovule per locule.

Fruit on pedicel 0.2 mm long, ovoid-subcylindrical, 1.3 mm long, 0.9 mm wide, very weakly 8-ribbed, shortly scabrous with appressed hairs or glabrous; sepals persistent, erect, enclosing styles, broadly ovate to deltoid, 0.5-0.6 mm long, 0.5-0.6 mm wide, prominent median basal callus, glabrous; pericarp membranous, 1 seed.

Distribution: *G. rudis* is confined to the Stirling Ranges in south-western Western Australia (Fig. 292).

Ecology: Dorien-Smith (PR530028) recorded that his collection came from "sand plains". Other collections were obviously made in the ranges. Flowering occurs in October.

Specimens examined:

WESTERN AUSTRALIA: Canning s.n., 25.x.1968, Stirling Range National Park, track up Toolbrunup, PERTH (fl.); *Dorien-Smith s.n.*, sand plains about Warrungup [Hill], PR530028 (fl.); *Drummond 4th colln., 81*, Swan River [colony], CGE, G (herb. Boiss. — 2 sheets), LE, MEL (4 sheets), W (fr.) — types of *H. rudis*; *Phillips s.n.*, 9.x.1962, Stirling Range National Park, on Mt. Josephine, CBG036972 (fl.).

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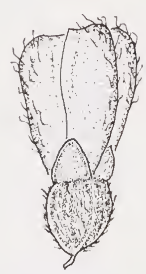

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Figs. 292-294. *Gonocarpus rudis*. 292. Distribution. 293. Bud. 294. Flower with primary and secondary bracts. (figs. 293, 294 from *Dorien-Smith s.n.*, PR). Scale represents 1 mm (figs. 293, 294).

All of the type specimens are sterile, with the exception of MEL39256, which has only 2 fruits, one attached, one in a packet. However, even sterile specimens of this species are easily identified by their distinctive habit; there is in all specimens so far collected a distinct "trunk" 1.5-6.0 cm long between the roots and the lowermost branches.

This species is poorly represented in herbaria, and the few existing collections show considerable variation; e.g. the Phillips specimen has functionally female flowers, with abortive petals and stamens, while other collections have fully bisexual flowers, the Dorien-Smith collection has flowers with glabrous ovaries (pilose in all others), and there are also marked differences in the shape of the ovary and the strength of its ribbing from one collection to another.

The Drummond collections in some European herbaria are described as coming from "Swan River". All recent collections have come from the Stirling Range, so it is likely that "Swan River" is an abbreviated form of "Swan River Colony", and that Drummond's collections also come from the Albany region.

25. **Gonocarpus trichostachyus** (Benth.) Orchard (Fig. 295)

Gonocarpus trichostachyus (Benth.) Orchard, comb. nov.

Haloragis trichostachya Bentham, Fl. Aust. 2 (1864) 481-2 [Typus: "N. Australia, Drummond, n. 205." Holotypus: n.v. Isotypi: *Drummond Coll. 3, 205,* Swan River, G (herb. Boiss., DC.)! W! (fr.); *Drummond 205,* Swan River, CGE! LE! (fl., fr.); *Drummond 205,* Swan River Colony, G (herb. Deless.) (fr.)!; *J. Dr. 205,* W.A., MEL 39523 (fr.)!] F. v. M., Census 1 (1882) 49; F. v. M., Sec. Census 1 (1889) 85; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 30, 40; Schindler, Pflrch 23 (1905) 40; Ewart & Davies, Fl. N. Terr. (1917) 214; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 467.

Fig: Blackall & Grieve, W. Aust. Wildfls 3 (1965) 467.

Erect herb 10-15 cm tall, stems red-brown, not ribbed, glabrous or sparsely scabrous with appressed, whitish unicellular hairs 0.1-0.2 mm long.

Leaves decussate, sessile, oblanceolate, 5.0-8.0 mm long, 1.5-2.5 mm wide, margin thickened, crenulate, midrib faint, lateral veins obscure, glabrous, or scabrous on margins and lower surface, with hairs as for stems.

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Lateral inflorescences arise in axils of reduced upper leaves, and are themselves often branched. Primary bracts linear, 1.3-1.5 mm long, 0.2-0.3 mm wide, entire, ± glabrous. Secondary bracts membranous, brown, ovate, 0.4 mm long, 0.25-0.3 mm wide, glabrous.

Flowers 4-merous, not seen perfect. Sepals 4, ovate to orbicular, 0.4 mm long, 0.4 mm wide, smooth, glabrous. Petals 4, hooded, keeled, 1.1 mm long, 0.3 mm wide, scabrous on keel. Stamens 8, anthers yellow, linear-oblong, 0.9 mm long, 0.2 mm wide, 4-celled, nonapiculate. Styles 4.

Fruits on pedicels 0.2-0.3 mm long, grey, ovoid to turbinate, 0.8-0.9 mm long, 0.6-0.7 mm wide, not or scarcely ribbed, scabrous; sepals persistent, erect, reddish, ovate, 0.6 mm long, 0.6 mm wide, obtuse, enclosing styles; pericarp membranous, 1 seed.

Distribution: The only properly localised collection of this species is from near Lake Wagin in south-western Western Australia. The record of *G. trichostachyus* from the Northern Territory (Ewart & Davies 1917) is the result of a misprint in the protologue of *H. trichostachya* (Bentham 1864) in which Drummond's collection was described as coming from "N. Australia" instead of "W. Australia" (Fig. 295).

Ecology: Nothing is known.

Fig. 295. Distribution of *Gonocarpus trichostachyus*.

SPECIMENS EXAMINED:

WESTERN AUSTRALIA: Cronin s.n., 1890, near Lake Wagin, MEL1003709 (st.); *Drummond 205*, Swan River Colony, CGE, G (herb. Boiss., DC., Deless.), LE, MEL, W (fl., fr.) — type of *H. trichostachya*.

All existing collections of this species are of poor quality, and none are known with complete flowers.

26. **Gonocarpus pusillus** (R. Br. ex Benth.) Orchard

Gonocarpus pusillus (R. Br. ex. Benth.) Orchard, comb. nov.

Haloragis pusilla R. Brown ex Bentham, Fl. Aust. 2 (1864) 481 [Typus: "W. Australia. To the E. of King Georges Sound, R. Brown (Herb. R. Br.)" Holotypus: n.v. Isotypus: *R. Brown s.n.*, K.G. Sd., MEL39220 ex K (fr.)!] F. v. M., Census 1 (1882) 49; F. v. M., Sec. Census 1 (1889) 85; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 30. 38; Schindler, Pflrch 23 (1905) 39; Britten, J. Bot. 45 (1907) 136-137; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 467.

FIGS.: Schindler, Pflrch 23 (1905) fig. 11D; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 467.

Erect herb 5-10 cm tall, rootstock a simple taproot; stems green, branched only from base, slender, not ribbed, glabrous.

Leaves opposite, becoming alternate in upper part, linear, 0.7-1.0 cm long, 0.1-0.15 cm wide, entire, acute, midrib obscure, sessile, glabrous.

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Lateral inflorescences absent. Primary bracts leaflike, linear-lanceolate, 1.7-2.0 mm long, 0.4-0.5 mm wide, entire, glabrous. Secondary bracts membranous, lanceolate, 0.8 mm long, 0.3 mm wide, glabrous.

Flowers not seen.

Fruits on pedicels ca 0.2 mm long, dark red-grey, ovoid to sub-turbinate, 0.7-0.8 mm long, 0.7 mm wide, 8-ribbed, glabrous; sepals persistent, erect, deltoid, subcordate and saccate at base, purplish with white thickened margins; pericarp membranous, 1 seed.

DISTRIBUTION: Known only from the type collection, found "E. of King Georges Sound" in south-western Western Australia.

ECOLOGY: Unknown.

SPECIMENS EXAMINED:

WESTERN AUSTRALIA: R. Brown s.n., K.G. Sd., MEL39220 (fr.) — type of *H. pusilla*.

The isotype of *H. pusilla* in MEL, on which the above description is based, lacks flowers. Schindler (1905) apparently based his description on a further isotype in B, now destroyed. This specimen lacked fruits, but had flowers described (transl.) as: "hermaphrodite, single in the axils of the leaves at the apex of the stems, very shortly pedicellate, pedicel ± 0.2 mm long, terete, glabrous; calyx tube obovoid to urceolate, apex constricted, 8-ribbed, ± 0.8 mm long and 0.7 mm diam., long and erectly pilose chiefly towards base, with 4 triangular, brown acute lobes with incurved apices, joined for total width of the base, the joint large, entire, adpressed to the apex of the tube, the lobes ± 0.4 mm long and 0.3 mm broad, subglabrous, thick, coriaceous rugulose; petals 4, non unguiculate, broad and strongly navicular, apex acute, subrostrate and hooded, ± 0.8 mm long and ± 0.3 mm wide viewed from the side, pilose on dorsal nerve; stamens 8, filaments ± 0.1 mm, anthers ± 0.4 mm long and 0.1 mm broad; styles 4, subcylindrical, incurved, with capitate, papillose stigmas; ovary 1-locular, 4-ovulate, the ovules pendulous around the columella from the top of the locules."

Schindler described and illustrated the ovary ("calyx tube") as pilose, and Blackall & Grieve (1965) show the fruit as being pilose. Yet the isotype in MEL has completely glabrous fruits. Bentham (1864) did not mention this aspect, which needs checking in the holotype.

27. **Gonocarpus eremophilus** Orchard (Figs. 296-299)

Gonocarpus eremophilus Orchard, sp. nov.

Herba perennis (15-) 25-35 cm alta, caules erecti vel ascendentes intricate ramosi 4-costati minute papillosae in costis.

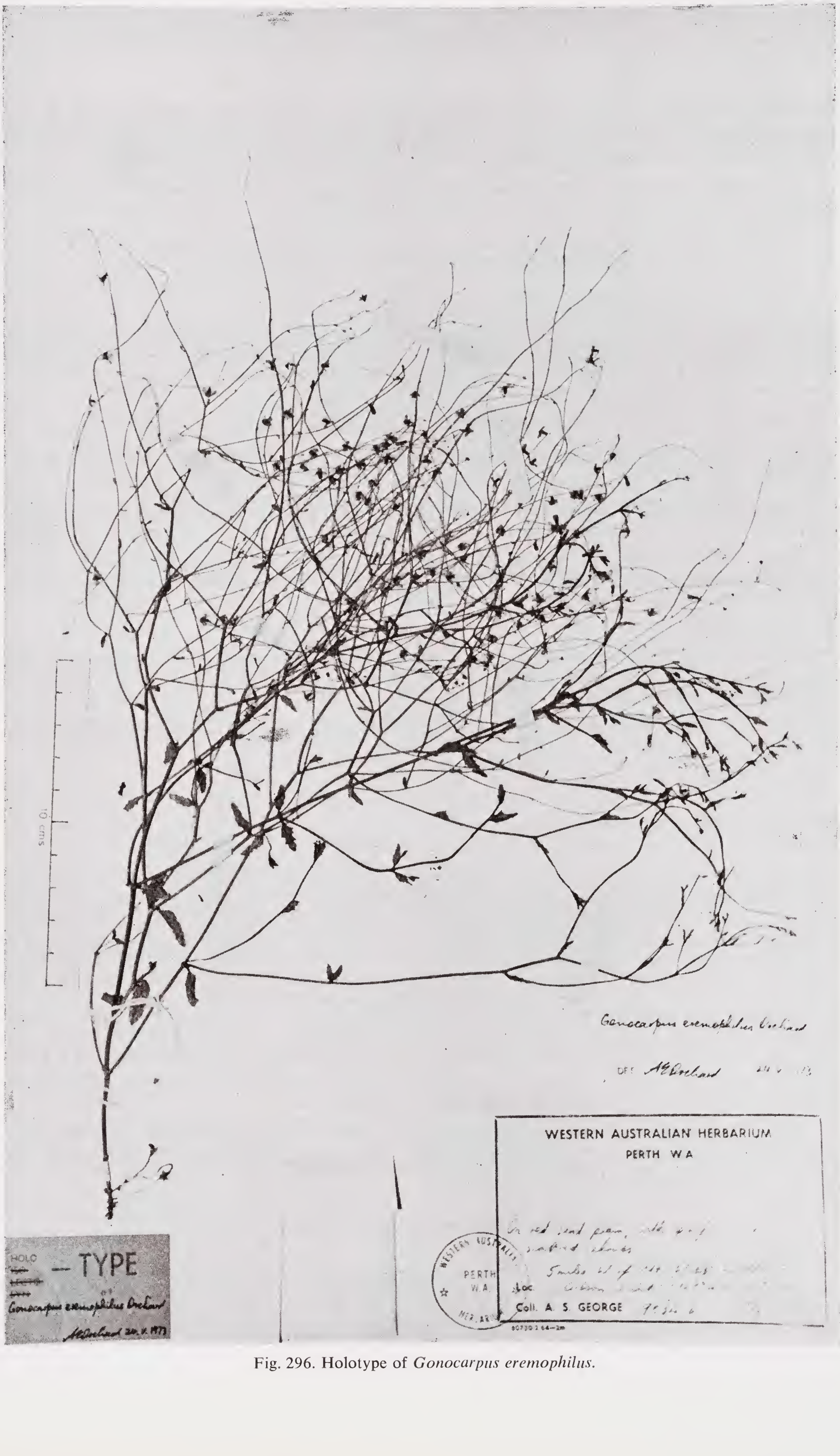


Fig. 296. Holotype of *Gonocarpus eremophilus*.

Folia decussata (alternata versus inflorescentiam) lanceolata 0.8-1.5 cm longa (0.2-) 0.4-0.6 cm lata ± sessilia (petiolus 1-2 mm longus) coriacea margine valde incrassata serrata dentibus 10-14 obtusis 0.5-0.7 mm longis glabra.

Inflorescentia spica indeterminata florum singulariter in axillis bractearum primariarum alternarum portatorum. Inflorescentiae multae laterales e foliorum summorum axillis ortae. Bracteae primariae foliaceae oblanceolatae 1.1-1.4 mm longae 0.3-0.4 mm latae integrae margine incrassata glabrae. Bracteae secundariae membranaceae cuneatae 0.2-0.4 mm longae 0.2-0.3 mm latae ad apicem truncatum dentibus minutis 3-4, glabrae.

Sepala 4, viridia deltoidea 0.6-0.7 mm longa 0.8-0.9 mm lata laevigata glabra. Petala 4, rosea cucullata carinata unguiculata (2.0-) 2.2-2.7 mm longa 0.6-0.7 mm lata (carina ad marginem) glabra. Stamina 8, filamenta 0.2 mm longa; antherae luteae lineares 1.5-1.8 mm longae 0.3 mm latae 4-cellulares nonapiculatae. Styli 4, clavati 0.4-0.5 mm longi; stigmata capitata. Ovarium violaceum cylindricum 1.5-1.7 mm longum 0.9-1.0 mm latum 8-costatum in costis papillosis aliter laevigatus; incomplete 4-loculare, ovulum 1 per loculum.

Fructus fuscus purpureo-griseus cylindricus 1.5-1.7 mm longus 0.9-1.0 mm latus 8-costatus in costis parce papillosis aliter laevigatus glaber; sepala persistentia erecta deltoidea 0.7-0.8 mm longa 0.8 mm lata styli includentes; semen unum.

Typus: *A. S. George 9034b,* 27.vii.1967, 5 miles [8 km] W. of Mt. Webb, northern Gibson Desert (128°4'E, 22°57'S). On red sand plain, with spinifex and scattered shrubs. Holotypus: PERTH (fl.)! (Fig. 296). Isotypus: AD96912115 (fl.)!

Perennial herb (15-) 25-35 cm tall, stems erect or ascending, green to red-brown, intricately branched, 4-ribbed, minutely papillose on ribs.

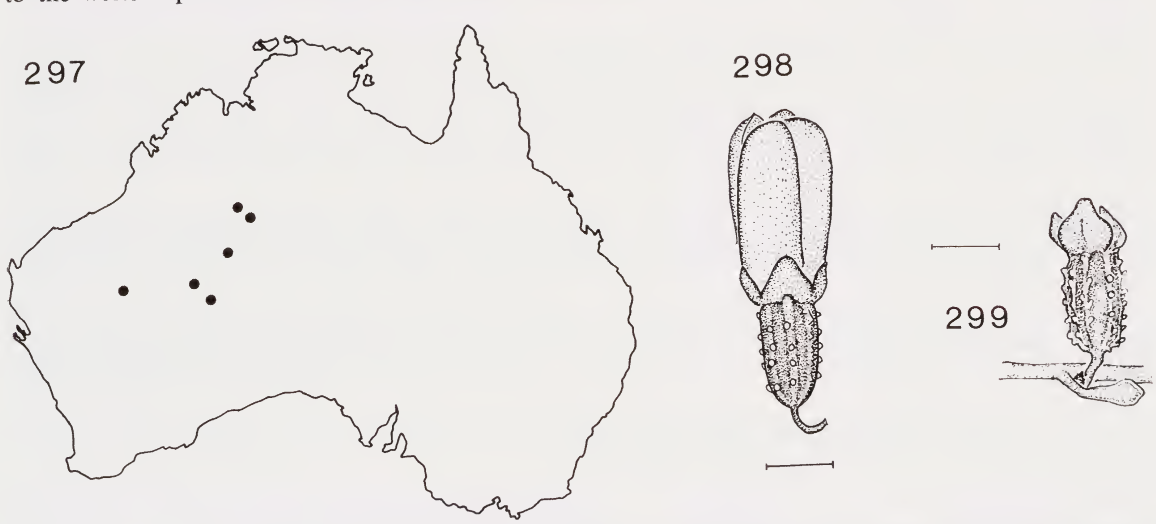
Leaves decussate, becoming alternate towards inflorescence, lanceolate, 0.8-1.5 cm long, (0.2-) 0.4-0.6 cm wide, ± sessile (petiole 1-2 mm long), coriaceous, margin strongly thickened, serrate with 10-14 blunt teeth 0.5-0.7 mm long, midrib obscure above, weakly prominent below, lateral veins obscure, glabrous.

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Numerous lateral inflorescences arise in axils of (often very reduced) upper leaves. Primary bracts green, fleshy, oblanceolate, 1.1-1.4 mm long, 0.3-0.4 mm wide, margins thickened, glabrous. Secondary bracts brown, membranous, cuneate, 0.2-0.4 mm long, 0.2-0.3 mm wide, truncate with 3-4 minute teeth, glabrous.

Flowers 4-merous on pedicels 0.3-0.5 mm long (Fig. 298). Sepals 4, green, deltoid, 0.6-0.7 mm long, 0.8-0.9 mm wide, smooth, glabrous. Petals 4, pink, hooded, keeled, unguiculate, (2.0-) 2.2-2.7 mm long, 0.6-0.7 mm wide (keel to margin), glabrous. Stamens 8, filaments 0.2 mm long; anthers yellow, linear, 1.5-1.8 mm long, 0.3 mm wide, 4-celled, nonapiculate, ± equisized. Styles 4, clavate, 0.4-0.5 mm long, stigmas capitate. Ovary reddish-purple, cylindrical, 1.5-1.7 mm long, 0.9-1.0 mm wide, 8-ribbed, papillose on ribs, otherwise smooth, incompletely 4-locular, 1 ovule per locule.

Fruit dark purplish-grey, on pedicel 0.5 mm long, cylindrical, 1.5-1.7 mm long, 0.9-1.0 mm wide, 8-ribbed, sparingly papillose on ribs otherwise smooth; sepals persistent, erect, deltoid, 0.7-0.8 mm long, 0.8 mm wide, enclosing styles; pericarp membranous, 1 seed (Fig. 299).

Distribution: *G. eremophilus* is confined to central Australia, extending from central Western Australia to the western part of the Northern Territory (Fig. 297).



Figs. 297-299. *Gonocarpus eremophilus.* 297. Distribution. 298. Flower. 299. Fruit with primary and secondary bracts. (figs. 298, 299 from *Latz 736*). Scales represent 1 mm (figs. 298, 299).

ECOLOGY: This species is confined to the red sanddune and sand plain country comprising the Great Sandy Desert and Gibson Desert, where it occurs in association with *Triodia* spp. and scattered shrubs. It is found flowering and fruiting from May until September.

SPECIMENS EXAMINED:

WESTERN AUSTRALIA: Donner 4495, 30.viii.1973, 11 miles [18 km] SW Warburton Mission, AD (fl., fr.); *George 9034b,* 27.vii.1967, 5 miles [8 km] W. of Mt. Webb, AD, PERTH (fl.) — type of *G. eremophilus*; *de Graaf 46,* -.v.1968, between NE of Wiluna and Everard Junction on Giles Highway (approx. 125°E, 25°S), PERTH (fl., fr.); *Royce 1610a,* 14.v.1947, Sandy Creek, 12 miles [19 km] N. of Jigalong, Rabbit Proof Fence, PERTH (fl.). *NORTHERN TERRITORY: Latz 736,* 2.viii.1970, 72 miles [115 km] W.S.W. of The Granites, AD NT (fl.); *Warder of Tanami s.n.,* -.viii-ix.1910, Tanami, AD96920070 (fl., fr.).

The specific epithet of this species records its preference for desert habitats. The local name for the plant in the vicinity of Mt. Everard is "Yul-ku-yul-ku" *(de Graaf 46)*.

As in several other species of *Gonocarpus,* occasional plants are known with functionally female flowers. The type of *G. eremophilus* is one of these, with antipetalous anthers 1.5 mm long and indehiscent, and vestigial antisepalous anthers 0.8 mm long.

28. **Gonocarpus micranthus** Thunb. (Figs. 300-306)

Gonocarpus micranthus Thunberg, Nov. Gen. 3 (1783) 69 n.v. et Fl. Jap. (1784) 69 [Typus: "Crescit iuxta Nagasaki, copiose." Isotypus: *Dr. Thunberg s.n.,* Japan, S (fr.)!] Koenig, Ann. Bot. 1 (1805) 546; DC., Prod 3 (1828) 66.

Haloragis tenella Brongn. in Duperrey, Voy. Coq. (Bot.) (1827-34) t. 68 [Typus: l.c., t. 68!; Holotypus: *Anon. s.n.,* N. Holl. detr. d'Entrecasteaux, P (fl.)!]; Hook. f., Fl. N.Z. 1 (1852) 63, Suppl. (1855) 328.

Haloragis micrantha (Thunb.) R. Br. ex Sieb. & Zucc., Fl. Jap. 1 (1835) 25 [R. Br. in Flind. Voy. 2 (1814) 550, comb. implied but not made]; A. Gray, Bot. U.S. Expl. Exped. 1 (1854) 626; Hook. f., Fl. Tasm. 1 (1856) 120, 121; Sonder, Linnaea 28 (1856) 230; Benth., Fl. Aust. 2 (1864) 481, 482, 484; F. v. M., Fragm. 8 (1874) 162, 10 (1876) 54; Hook. f., Fl. Brit. Ind. 2 (1878) 430; Baillon, Nat. Hist. Pl. 6 (1880) 491; Tate, Trans. R. Soc. S. Aust. 3 (1880) 64; F. v. M., Census 1 (1882) 49; Bailey, Syn. Qld. Fl. (1883) 157; Tate, Trans. R. Soc. S. Aust. 6 (1883) 96; Colenso, Trans. N.Z. Inst. 18 (1885-6) 260; F. v. M., Key Syst. Vict. Pl. 2 (1885) 22, 1 (1887-8) 263; F. v. M., Trans. R. Soc. Vict. 24 (1888) 134; Tate, Trans. R. Soc. S. Aust. 12 (1889) 86; F. v. M., Sec. Census 1 (1889) 86; Featon, Art Alb. N.Z. Fl. 1 (1889) 149; Tate, Fl. S. Aust. (1890) 101, 234; Moore, Hdbk. Fl. N.S. Wales (1893) 186; Petersen, Pflfam. III. 7 (1893) 230, 233; Kirk, Stud. Fl. N.Z. (1899) 149; Bailey, Qld. Fl. 2 (1900) 556; Rodway, Tas. Fl. (1903) 49; Diels & Pritzel, Bot. Jb. 35 (1904) 447; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 30, 42; Schindler, Pflrch 23 (1905) 42; Dixon, Pl. N.S. Wales (1906) 130; Maiden & Betche, Proc. Linn. Soc. N.S. Wales 31 (1906) 396, 398; Merrill, Philip. J. Sci. 1 Suppl. (1906) 217; Merrill, Philip. J. Sci. (Bot.) 2 (1907) 289; Cheeseman, Trans. N.Z. Inst. 42 (1909) 203; Cockayne, Rep. Bot. Surv. Stewart Is. (1909) 57; Bailey, Comp. Cat. Qld. Pl. (1913) 174; Guillaumin, Bull. Soc. Bot. France 61 (1914) 9, 10; Maiden & Betche, Census N.S. Wales Pl. (1916) 158; Gibbs, Phytogeog. & Fl. Arfak Mts. (1917) 159; Went, Nova Guinea 14 (1924) 107; Cheeseman, Man. N.Z. Fl. 2 ed. (1925) 623; Black, Fl. S. Aust. (1926) 430; Mansfeld, Bot. Jb. 61 (1927) 26; Domin, Bibl. Bot. 89 (1929) 1034; Ewart, Fl. Vict. (1931) 880; van Steenis, Bull. Jard. Bot. Buitenz. III. 13 (1934) 218; Hosakawa, Trans. Nat. Hist. Soc. Formosa 30 (1940) 335; Black, Fl. S. Aust. 2 ed. (1952) 642; Curtis, Stud. Fl. Tas. 1 (1956) 187; Moore, in Allan, Fl. N.Z. 1 (1961) 244; van Steenis, Endeavour 21 (1962) 187; Evans, in Beadle, Evans & Carolin, Hdbk. Vasc. Pl. Syd. Dist. (1963) 175; Eichler, Suppl. Black's Fl. S. Aust. (1965) 245; Ohwi, Fl. Jap. (1965) 660; Tardieu-Blot, Fl. Camb., Laos & Vietn. 4 (1965) 122, 123; Praglowski, Grana 10 (1970) 174; v.d. Meijden, Fl. Thailand 2 (1970) 3; Burbidge & Gray, Fl. A.C.T. (1970) 280; v.d. Meijden & Caspers, Fl. Males. 7 (1971) 244; Willis, Hdbk. Pl. Vict. 2 (1972) 468; Beadle et al., Fl. Syd. Reg. (1972) 207.

Goniocarpus depressus A. Cunn., Ann. Nat. Hist. 3 (1839) 30 [Typus: "New Zealand (Northern Island). Low boggy ground at Wangaroa - 1826, A. Cunningham." Holotypus: *A. Cunningham 85 (No. 531),* 1826, Wangaroa, New Zealand, K (fl., fr.)!] Raoul, Choix Pl. N.Z. (1846) 48; Hook. f., Fl. N.Z. 1 (1852) 63; Gray, U.S. Expl. Exped. 1 (1854) 626.

Goniocarpus citriodorus A. Cunn., Ann. Nat. Hist. 3 (1839) 30 [Typus: "New Zealand (Northern Island). In bogs, on the banks of the Keri Keri river, Bay of Islands. — 1834, Rich. Cunningham." Holotypus: *R. Cunningha ham 530,* 1834, Bogs about the Keri Keri, K (fr.).] Featon, Art. Alb. N.Z. Fl. 1 (1889) 149 ['*Goniocarpus citrio dours*'].

Haloragis citriodora (A. Cunn.) Walp., Rep. 2 (1843) 99.

Haloragis depressa (A. Cunn.) Walp., Rep. 2 (1843) 99.

Goniocarpus rotundifolius F. v. M. ex Hook. f., Fl. Tasm. 1 (1856) 121, nom. illeg.

Haloragis minima Colenso, Trans. N.Z. Inst. 18 (1885-86) 259 [Typus: "Hab. Tarawera, high lands between Napier and Taupo; December, 1884; Mr H. Hill." Holotypus: WELT (fide Moore in Allan, 1961) n.v., Isotypus: *H. Hill per Rev. W. Colenso s.n.,* Tarawera between Napier and Taupo, AK133495 (fl.)!].

Figs.: Thunb., Fl. Jap. (1784) t. 15; Brongniart in Duperrey, Voy. Coq. (Bot.) (1827-34) t. 68; Schindler, Pflrch 23 (1905) fig. 12; Moore, in Allan, Fl. N.Z. 1 (1961) fig. 11; Praglowski, Grana 10 (1970) pl. 41; v.d. Meijden & Caspers, Fl. Males. 7 (1971) 242, fig. 1.

Prostrate or ascending creeping or erect herbs, glabrous or rarely very slightly scabrous on stems and petioles with scattered, appressed, simple, unicellular hairs 0.1-0.2 mm long. Stems smooth (not ribbed or winged), rooting at the lower nodes, ± intricately branched, with 1-3 lateral branches arising from the axil of a single leaf. Leaves decussate, shortly (0.6-2.0 mm) petiolate, orbicular to ovate, sometimes almost cordate or lanceolate, 0.4-1.3 cm long, 0.3-1.1 cm wide, rounded or cordate at base, acute to obtuse at the apex, margins thickened, serrulate with (4-) 8-20 (-30) small crenate teeth, midrib ± prominent below, smooth above, lateral veins indistinct.

Inflorescence an indeterminate spike of single flowers borne in the axils of alternate primary bracts. Lateral inflorescences are borne in the axils of the upper leaves, and the lateral inflorescences may themselves bear branchlets, and so on, up to the 4th order of branching. Primary bracts lanceolate, 0.5-0.8 -(1.0) mm long, 0.1-0.2 mm wide, membranous, entire. Secondary bracts (bracteoles) ± orbicular, 0.1-0.2 mm long, 0.1-0.2 mm wide, membranous, serrulate or entire. All bracts deciduous, at or about anthesis.

Flowers pendant, on pedicels 0.1-0.3 mm long (Figs. 304, 306). Sepals 4, green, deltoid, 0.4-0.5 mm long, 0.3-0.4 mm wide, with median basal callus. Petals 4, reddish, hooded, keeled, 0.8-1.3 (-1.5) mm long, 0.2-0.4 mm wide, glabrous. Stamens 8, filaments 0.1-0.3 mm long; anthers yellow or red, oblong, (-0.5) 0.7-0.9 mm long, 0.1-0.2 mm wide, 4-celled, nonapiculate. Styles 4, stigmas red to yellow, fimbriate. Ovary obovoid, 0.6-0.9 mm long, 0.5-0.7 mm wide, tapering gradually towards base, shortly contracted at apex, shiny red to grey with 8 prominent longitudinal ribs, glabrous, incompletely 4-locular, with 4 pendulous ovules.

Fruit reddish to grey, obovoid, 0.7-0.9 mm long, 0.6-0.7 (-0.8) mm wide, 8-ribbed, glabrous, or rarely with short, curved unicellular hairs arising from tubercles on the ribs; sepals persistent, erect, deltoid, 0.4-0.6 (-0.7) mm long, 0.3-0.4 (-0.5) mm wide, with a median basal callus; 1 seed, occupying entire fruit.

Key to subspecies of *G. micranthus*

Inflorescence narrow, unbranched, or branching only to the 2nd order; all inflorescence branches ± erect. Plants usually prostrate, 5-10 cm tall. Leaves (3.0-) 4.0-7.0 mm long, (1.0-) 4.0-6.0 mm wide. subsp. *micranthus*

Inflorescence diffuse, branching to the 3rd and 4th order; the final inflorescence branches ± horizontal. Plants erect, 25-60 cm tall. Leaves (8.0-) 10.0-13.0 mm long, (7.0-) 8.0-12.0 mm wide. subsp. *ramosissimus*

subsp. **micranthus**

Prostrate or ascending creeping herb, stems rooting at nodes (Fig. 303); in open situations the stems become stoloniferous and give rise to cushion plants 5-10 cm tall; in dense undergrowth the stems are supported by surrounding plants and may reach 30 cm tall. Leaves (lanceolate-) ovate-cordate, (3.0-) 4.0-7.0 mm long, (1.0-) 4.0-6.0 mm wide. Inflorescence narrow, unbranched (i.e. no lateral inflorescences) or branched only to the 2nd order, and then all branches are ± erect. Flowers and fruits as for species.

Distribution: This is the most widespread of the two subspecies, extending from south-eastern Australia to New Zealand, New Guinea, Java, Borneo, Philippines and south-eastern Asia, including Japan, Formosa, China, Indo-China, Thailand, Sikkim and Assam (Figs. 300-302).

Ecology: *G. micranthus* subsp. *micranthus* favours wet or boggy places, either in open or grassy situations. It has been found at altitudes ranging from sea level to about 3000 m, and often occurs in alpine meadows where it is covered with snow for several months of the year. Collectors' notes include "hilly granite country near small running creek" (*Burbidge & Gray 4451*); "alpine bog land" (*Schodde 3221*); "in sphagnum bogs and on wet surfaces along streams etc." (*Costin 0021*); "in damp soil among sandstone rocks"; (*Rodway 2579*); "in sandy soil in heathland" (*Muir 3332*); "common in small flat masses on burnt grasslands" (*Brass 4645*) and "growing on mud and floating debris at water level" (*Orchard 2030*). Within Australia and New Zealand, flowering occurs from about December to February and fruiting from December to March. In New Guinea and the northern hemisphere flowering and fruiting times are earlier.

Native names: Tigitoka (Enga language, Poio, Papua New Guinea; *Hoogland & Schodde 7150*); Tan (Enga language, Wabag; *Hoogland & Schodde 7582*); Ari-no-tō-gusa (Japan; Ohwi, 1965).

Specimens examined:

JAPAN: Arimoto s.n., 25.vii.1903, Settsu, GH (fl.); *Arimoto s.n.*, 4.viii.1903, Mimasaka, GH (fl.); *Arimoto s.n.*, 5.ix.1903, Yezo, GH (fl., fr.); *Buek s.n.*, Japan, HBG (st.); *Buerger s.n.*, Japan, M (fl., fr.); *Burmann s.n.*, Japan, G (herb. Deless.) (fl., fr.); *Hasegawa s.n.*, 13.vii.1965, Mt. Aso, Kyushu, TI (fl.); *Maekawa s.n.*, 28.vii.1935,

Sikkim, GH (fl.). *ASSAM: Griffith 2438,* East Bengal, GH, M (st.); *Hooker & Thomson s.n.,* Khasia, CGE, GH, M, NY (fl., fr.). *THAILAND: Tagawa et al. 516,* 28.xi.1965, Udawn, Loey, Phu Kradung, A (st.). *N. VIETNAM: Petelot 3198,* -.viii.1927, Chapa, NY (fr.); *Petelot 5663,* 8.iii.1938, Phu Io, Prov. Phuc Yen, GH (fl.). *PHILIPPINES: Copeland 1436,* -.x.1904, Mt. Apo, Mindanao, NY (fr.); *Curran 17380,* -.viii.1909, Mt. Canlaon, Negros, BISH (st.); *Elmer 11378,* -.viii.1909, Todaya (Mt. Apo), Mindanao, BISH, NY (fr.); *Jacobs 7247,* 30.i.1968, Mt. Pulog, Luzon, PNH (fr.); *Mearns s.n.,* -.vii.1907, Heights in the Oaks, Benguet Prov., Luzon, NY (fl., fr.); *Merrill s.n.,* -.iv.1910, Canlaon Volcano, Negros, BRI030068 (fl.); *Merrill 861,* -.v.1911, Benguet subprov., Luzon, M, U (fl., fr.); *Merrill 5787,* -.xi.1906, Mt. Halcon, Mindoro, NY (st.); *Merrill 6591,* -.v.1909, Mt. Pulog, Luzon, NY (st.); *Santos s.n.,* -.iv-vi.1918, Pauai, Luzon, BRI080069, GH (fl.). *SABAH: Clemens 10527,* 11-15.xi.1915, Kamburanga, Mt. Kinabalu, GH, PNH (fl., fr.); *Clemens 10907,* 22-23.xi.1915, Marai Parai Spur, Mt. Kinabalu, PNH (st.); *Clemens & Clemens 27799,* 7.i.1932, Kamburanga, Mt. Kinabalu, A, M, NY (fl., fr.); *Clemens & Clemens 32815,* 12.iv.1933, Marai Parai, Mt. Kinabalu, NY (fl.); *Clemens & Clemens 51681a,* 2.xii.1933, Gurulau, head of Kadmian River, Upper Kinabalu, GH (fl.); *Jacobs 5741,* 15.x.1958, Tenompok - Kamburanga - Paka Caves - summit, Mt. Kinabalu, CANB, PNH (fl.); *Meijer s.n.,* 6.xi.1959, Kamburanga, Mt. Kinabalu, PNH64491 (fl.). *INDONESIA: van Steenis 4246,* 29.iii.1930, Priangan, G. Papandajan, Tegal Pandjang, NY (fr.). *WEST IRIAN: Brass 9194, 9435,* -.viii.1938, Lake Habbema, A, BRI (fl., fr.); *Kanehira & Hatusima 13534,* 5.iv.1940, Angi, Arfak Mts, A (fr.). *PAPUA NEW GUINEA: Brass 4645,* -.vi-ix.1933, Murray Pass, Wharton Range, BRI, NY (fl., fr.); *Brass 22248,* 19.v.1953, Maneau Peak, Mt. Dayman, A, CANB (fl., fr.); *Clemens & Clemens 5301,* 1.ii.1937, Goliteng, Salawaket, A (fl.); *Flenley ANU2170,* 11.xii.1964, Lake Inim, CANB (fl., fr.); *Hartley 11124,* 19.i.1963, base of Mt. Salawaket, A, CANB (fl., fr.); *Henty & Carlquist NGF16623,* Mt. Piora, BRI, CANB (fl., fr.); *Hoogland 9501,* 6.viii.1964, Mannasat, Cromwell Mountains, A, CANB (fl.); *Hoogland & Schodde 7150,* 19.vii.1960, northern slopes of Sugarloaf complex, CANB (fr.); *Hoogland & Schodde 7479,* 18.viii.1960, Yobobos grassland area, source of Lagaip River, CANB, PNH (fl.); *Hoogland & Schodde 7582,* 25.viii.1960, Yobobos grassland area, CANB (fl., fr.); *Kalkman 4831,* 9.vii.1966, Mt. Kerewa, CANB, PNH (fl., fr.); *Robbins 266,* 6.vii.1957, road above Tomba, A, CANB (fl., fr.); *Robbins 382,* 11.vii.1957, Kaugel Valley, Tambil, CANB (fl., fr.); *Schodde 1784,* 11.viii.1961, Mt. Giluwe, A, CANB (fl., fr.); *Schodde 5483,* 19.vii.1969, Mt. Wadimana, CANB (fl., fr.); *Vink 16284,* 17.viii.1963, Mt. Kinkain, Kubor Range, BISH, CANB (fl.); *Vink 17289,* 29.vii.1966, Mt. Ambua, CANB (fl., fr.); *Walker ANU631,* 29.viii.1962, Lake Iviva, Sirunke, CANB (fl.). *QUEENSLAND: Bufton 65,* 1893, Bathurst Harbour, MEL (fl., fr.); *Mueller s.n.,* Moreton Bay, MEL1003590 (fl.). *NEW SOUTH WALES: Anon. 324,* Dec., Timbarra, MEL1003602 (fl.); *Baenerlen 56,* -.iii.1885, Genoa district, MEL (fl., fr.); *Baenerlen 194,* -.xi.1884, Braidwood district, MEL (fl.); *Beadle s.n.,* 7.ii.1952, Kosciusko, NE, SYD (fl., fr.); *Boorman s.n.,* -.xi.1914, Clyde, Paramatta R., AD, BRI, NSW, SYD (fl., fr.); *Burbidge 6358,* between Blackfellow's Gap & Upper Cotter, CANB (fr.); *Burbidge & Gray 4451,* 17.i.1958, Bendora to Mt. Franklin, CANB (fr.); *Burgess s.n.,* 24.ix.1962, Wentworth Falls, CBG006243 (fl.); *Caley s.n.,* Nouvelle Hollande, G (fl.); *Cambage 3154,* 4.xii.1911, Mt. Werong, NSW (fl.); *Cambage 3297,* 14.i.1912, Upper Cotter, Queanbeyan, NSW (fr.); *Cambage 4118,* 7.xi.1914, Old Racecourse, Ulladulla, NSW (fl., fr.); *Carolin s.n.,* 30.xi.1963, Mellag Swamp, SYD (fl.); *Carolin 905,* 22.iii.1959, Mt. Maxwell, SYD (fr.); *Carroll s.n.,* 17.i.1966, Happy Jack's Plains, CBG017597 (fl., fr.); *Cheel s.n.,* -.ii.1912, Colo, NSW99164 (fl.); *Constable s.n.,* 14.xii.1948, Wolgan East, NSW28226 (fl.); *Constable s.n.,* 12.xii.1960, 2 miles [3 km] W. of Penrith, NSW55717 (fl., fr.); *Constable 7327,* 22.ii.1967, Sans Souci, NSW (fl., fr.); *Costin 0021,* -.i.1958, Mt. Stilwell, CANB (fl., fr.); *Coveny 786,* 23.i.1969, 14 miles [22 km] S.E. of Wilton, NSW (fl., fr.); *Eichler 13458,* 24.i.1957, ca 9 km E.N.E. of Mt. Kosciusko, AD (st.); *Eichler 13479,* 25.i.1957, ca 8 km E.N.E. of Mt. Kosciusko, AD (fl.); *Evans s.n.,* -.i.1932, Blackheath Water reserve, SYD (fl.); *Evans 2570,* -.x.1924, LaPerouse, Botany Bay, SYD (fl.); *Field s.n.,* New South Wales, BRI080047 (fl.); *Forsyth s.n.,* -.xii.1901, Kiandra, NSW98923 (fl.); *Fraser & Vickery s.n.,* 7.i.1934, Barrington Tops, NSW98926 (fl., fr.); *Gauba s.n.,* 6.vii.1950, Badja Mountain, CBG015105 (fl.); *Heron s.n.,* -.v.1899, Conjola, NSW99154 (fl., fr.); *Johnson s.n.,* 1.xii.1954, Barrington Tops, NSW98927 (fl.); *Johnson 920,* 18.i.1947, Jibbon Hill, NSW (fl., fr.); *Johnson & Constable s.n.,* 25.i.1957, Digger's Creek, Kosciusko, NSW18817 (fr.); *Lumley 5,* 2.iv.1941, Wardell, Richmond River, NSW (fr.); *Maiden s.n.,* -.xi.1896, Port Jackson district, AD96905139 (fr.); *Maiden s.n.,* -.i.1898, Mt. Kosciusko, NSW98919 (fr.); *Maiden & Forsyth s.n.,* -.i.1899, Pretty Point, Mt. Kosciusko, NSW98920 (fr.); *Martin s.n.,* 19.i.1957, Boggy Plain, Kosciusko, SYD (fr.); *McBarron 1336,* 2.i.1948, Tumbarumba, SYD (fl., fr.); *McBarron 7478,* 5.ii.1963, Linden, NSW (st.); *McKee 10149,* 27.ii.1963, Mt. Gingera, NSW (fr.); *McKee 11656,* 6.x.1964, Duranbah, CANB (fl.); *Meebold s.n.,* -.v.1933, Rose Bay, Sydney, M (terat.); *Moore s.n.,* 7.ii.1959, Mt. Kosciusko area, CANB94799, 94802 (fl., fr.); *Moore 2268,* 4.ii.1953, Mt. Gingera, CANB (fr.); *Moore 3343, 3348,* 26.i.1961, near Cabrumurra, CANB (st.); *Mueller s.n.,* Paramatta, MEL1003595, 1003605 (fl.); *Orchard 2395,* 29.x.1969, top of Bulli Pass, ca 5 km west of Wollongong, AD (fl.); *Phillips-Carroll s.n.,* 9.i.1963, Happy Jack's, CBG015624 (fl., fr.); *Rodd s.n.,* 15.xi.1964, Kanangra Tops, NSW98934 (fl.); *Rodway s.n.,* 26.xii.1925, Bowen Island, Jervis Bay, NSW99151 (fl., fr.); *Rodway s.n.,* 19.x.1941, 6 miles [10 km] S.W. of Nowra, NSW99149 (fl., fr.); *Rodway 148,* 25.x.1930, Jervis Bay, Huskisson, BISH (fl., fr.); *Rodway 224,* 30.xi.1930, Fitzroy Falls, NSW (fl.); *Rodway 2579,* 27.ix.1937, 3 miles [5 km] S.W. of Nowra, NSW (fl.); *Rumsey s.n.,* -.x.1895, Barber's Creek, NSW98932 (fl.); *Salasoo 884,* 20.x.1951, E. of Wahroonga, NSW (fl.); *Salasoo 922,* 2.ii.1952, Roseville Chase, NSW (fl.); *Schodde 1280,* 8.ii.1961, Bendora, Brindabella Range, AD, CANB (fr.); *Schodde 3221,* 3.ii.1963, ca 40 miles [65 km] north of Singleton, CANB (fr.); *Simmonds s.n., -.iv.1897,* Richmond River, BRI1080060 (st.); *Tenison-Woods s.n.,* 30.xii.1882, Wentworth Falls, BRI080056 (fl.); *Thompson 87,* 17.i.1958, ca 15 miles [24 km] S. of Kiandra, NSW (fl., fr.); *Thompson 263,* 19.i.1970, between Mt. Piper and Back Perisher, NSW (fl., fr.); *Thompson 472,* 25.i.1970, Blue Cow Creek, NSW (fl.); *Thompson 1347,* 17.i.1972, Etheridge Range, NSW (st.); *Walker ANU190,* 11.ii.1962, Kosciusko, CANB (fl., fr.); *Walker ANU 988,,* -.xii.1962, Currango, CANB, NSW (fl.); *Whaite 816,* 24.xii.1950, Carrington Falls, Robertson, NSW (fl.); *Whaite 1103,* 30.xii.1951, Glen Raphael, NSW (fl.); *Whaite 2976,* 24.x.1965, 10 miles [16 km] south of Sassafras, NSW (fl.); *Williams s.n.,* 16.xii.1967, 45 miles [70 km] E of Armidale, NE (fl.); *Wrigley s.n.,* 24.vi.1969, 3 miles [5 km] S. of Bonny Hills towards Laurieton Swamp, CBG028839 (fl., fr.); *Verreaux 152,* 1844, Botany Bay, P (terat.). *VICTORIA: Allender s.n.,* 16.i.1961, Echo Flat, Lake Mountain, MEL1003582 (fr.); *Allitt s.n.,* Portland, MEL1003623 (fl., fr.); *Beauglehole 15337,* 22.i.1966, Mt. Baw Baw, BEAUG (fr.); *Beauglehole 15413,* 25.i.1966, Bogong High Plains, BEAUG (fr.); *Beauglehole 15596,* 26.i.1966, Bogong High Plains, BEAUG (fl., fr.); *Beauglehole 16363,* 9.xii.1967, Wannon River, Grampians, BEAUG (fr.); *Beauglehole 17016,* -.xii.1946, Port-

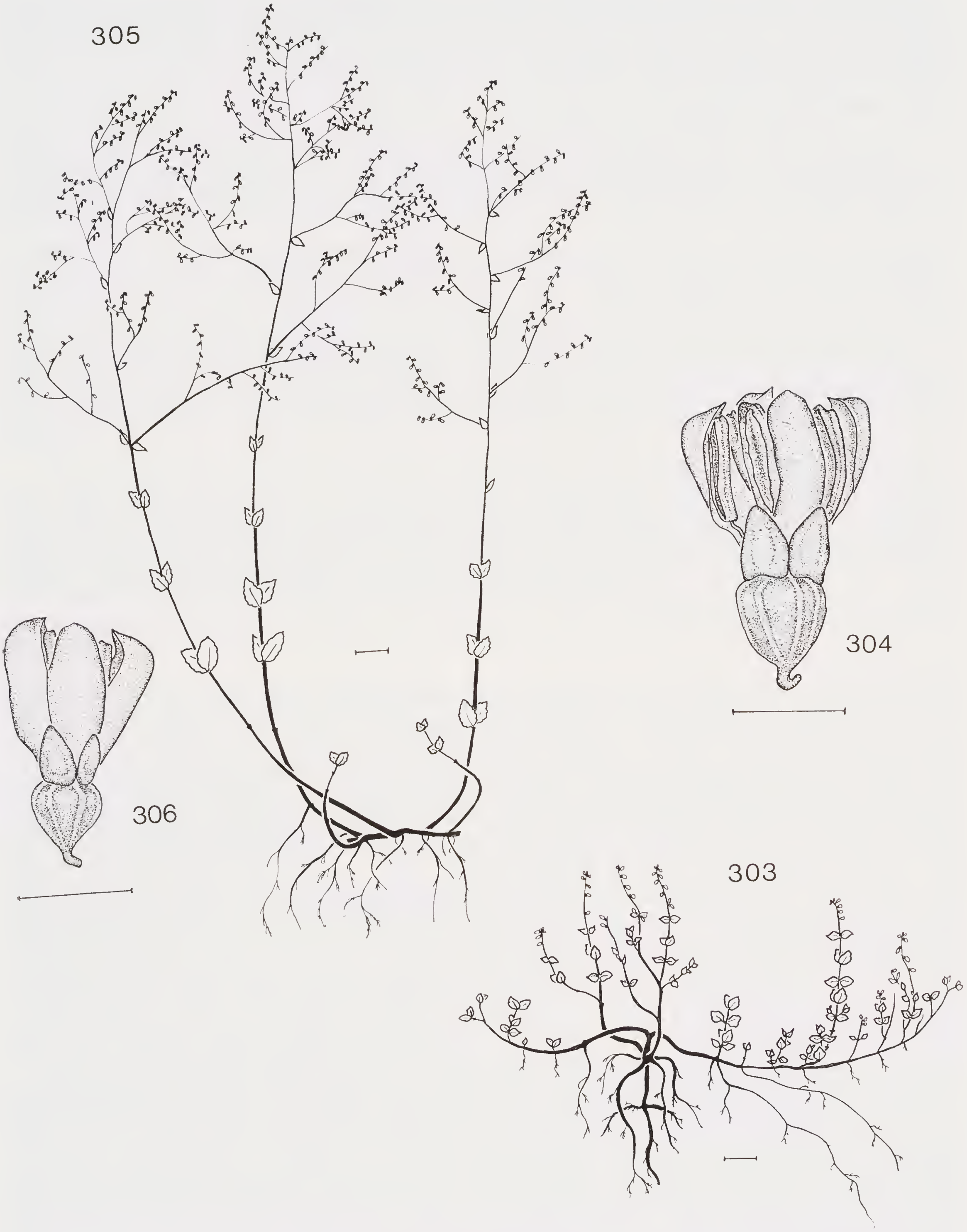
Figs. 301, 302. Detailed distribution of *Gonocarpus micranthus* in Australia and New Zealand (● = subsp. *micranthus*, ○ = subsp. *ramosissimus*).

land, BEAUG (fl.); *Beauglehole 30552,* 19.ii.1969, N. of Wannon River Bridge, Grampians, BEAUG (fl.); *Beauglehole 30847,* 2.vii.1969, N. of Sugarloaf Hill, Grampians, BEAUG (fl.); *Beauglehole 31219,* 13.x.1969, ± 13½ miles [21.5 km] direct S.W. of Mallacoota P.O., BEAUG (st.); *Beauglehole 31282,* 26.x.1969, Marlo Aerodrome, AD, BEAUG (fl.); *Beauglehole 31290,* 27.x.1969, 1 mile [2 km] E. of Marlo, BEAUG (fl.); *Beauglehole 31677,* 13.xi.1969, ± 20½ miles [33 km] direct S.W. of Mallacoota P.O., BEAUG (st.); *Beauglehole 31707,* 14.xi.1969, ± 7 miles [11 km] direct N.W. of Mallacoota P.O., BEAUG (fl., fr.); *Beauglehole 32213,* 8.xii.1969, ± 2½ miles [4 km] W. of Genoa P.O., BEAUG (fl.); *Beauglehole 32628,* 20.xii.1969, East Wingan Road, East Gippsland, BEAUG (fr.); *Beauglehole & Finck 31975,* 22.xi.1969, Cicada Trail, East Gippsland, BEAUG (fl.); *Beauglehole & Finck 32128,* 5.xii.1969, ± 4 miles [6 km] direct N.W. of Mallacoota P.O., BEAUG (fl.); *Beauglehole & Finck 32951,* 29.xii.1969, E. of Top Lake, Mallacoota Inlet, AD, BEAUG (fl., fr.); *Beauglehole, Rogers & Finck 33318,* 7.i.1970, Benambra-Wulgulmerang road, BEAUG (fl., fr.); *Beauglehole & Willis 31518,* 4.xi.1969, ± 3½ miles [5.5 km] direct E.N.E. of Mallacoota P.O., BEAUG (fl.); *Beauglehole & Willis 31563,* 6.xi.1969, ± 6 miles [9.5 km] direct E.N.E. of Mallacoota P.O., BEAUG (st.); *Beauglehole & Willis 31593,* 8.xi.1969, ± 6 miles [9.5 km] direct N.E. of Mallacoota P.O., BEAUG (fl.); *Belcher 729,* 7.xi.1967, about 1½ miles [2.5 km] N. of Mt. Kincaid, MEL, PERTH (fl.); *Brown s.n.,* Port Albert, MEL1003628 (fl.); *D'Alton 1,* the Grampians, MEL (fl., fr.); *Eichler 14675,* 2.ii.1958, Fall's Creek, Bogong High Plains, AD (fr.); *French s.n.,* -.i.1889, Bendac, MEL1003654 (fl., fr.); *Gates 21,* 1891, Ovens River, MEL (fl., fr.); *Hart s.n.,* Croydon, MEL1003578 (fl.); *Hart s.n.,* 30.xii.1938, Dingley, between Dandenong and Cheltenham, MEL1003579 (fl., fr.); *Lehmann & French s.n.,* -.xii.1892, Mt. Mueller, MEL1003658 (fl.); *Lucas s.n.,* 1883, Myrtleford, MEL1003633 (fl.); *Meebold 2122,* -.xii.1928, Healesville, Black Spur, M (fl.); *Meebold 2438,* -.i.1929, Wilson's Promontory, AD, M (st.); *Meebold 6055,* -.xi.1929, Pakenham, M (fl., fr.); *Merrah s.n.,* -.v.1887, Head of Bendoc River, MEL 1003638 (fr.); *Morrison s.n.,* 10.i.1892, Frankston, CANB127117 (fr.); *Morrison 2076,* 7.i.1892, Oakleigh, AD,

BISH, CANB, MEL, NSW, PERTH, PNH (fl.); *Morrison 2077,* 17.xii.1892, Oakleigh, AD, CANB, MEL, NSW (fl.); *Mueller s.n.,* Port Phillip, MEL1003785, 1003795 (fl., fr.); *Mueller s.n.,* -.i.1850, Dandenong Ranges MEL1003624 (fl., fr.); *Mueller s.n.,* 26.ii.1850, Mount Buller, MEL1003627 (st.); *Mueller s.n.,* 19.iv.1853, Mount Ararat, MEL1003763 p.p.; *Mueller s.n.,* -.v.1853, Alberton, MEL1003629 (st.); *Mueller s.n.,* -.xii.1856, South Port, MEL1003615, 1003616 (fl.); *Mueller s.n.,* -.xii.1862, Mount Useful, MEL1003626 p.p., 1003639 (fl.); *Mueller s.n.,* -.xii.1879, Curdies River, MEL1003632 (fl.); *Muir 722,* 21.i.1959, Falls Creek, Bogong High Plains, MEL (fl., fr.); *Muir 1944,* 26.xi.1960, 2 miles [3 km] east of Cann River, Princes Highway, MEL (fl.); *Muir 3110,* 3.i.1964, about 2 miles [3 km] south-west of Mt. Wellington, MEL (fl.); *Muir 3332,* 17.ii.1964, 12 miles [19 km] east-north-east of Stratford, MEL (fl., fr.); *Muir 3759,* 14.i.1965, 7 miles [11 km] north-west of Mt. Wellington, MEL (fl., fr.); *Muir 3830,* 26.i.1966, 1 mile [2 km] north of Mt. Wellington, MEL (fl., fr.); *Orchard 1883,* 7.ii.1969, ca 32 km north-east of Hamilton, AD (fr.); *Orchard 1905,* 8.ii.1969, ca 55 km north-east of Hamilton, AD (fl.); *Orchard 2003, 2004,* 13.ii.1969, ca 24 km west of Heywood, AD (fl., fr.); *Orchard 2015,* 13.ii.1969, ca 30 km west of Heywood, AD (fl., fr.); *Reader s.n.,* 3.xii.1905, County of Follett, MEL1003644 (fl.); *Robbins 17027,* 1937, Boggy Creek, East Gippsland, BEAUG (fl.); *Robbins 17093,* 9.i.1951, Mt. Buffalo, BEAUG (fr.); *Robbins 17094,* 1940, Lower Euroben Creek, BEAUG (fr.); *Skewes s.n.,* 21.i.1952, Middle Creek, Bogong High Plains, UPS (fl., fr.); *Stewart s.n.,* 12.i.1950, Mt. Buffalo, BRI080107 (fr.); *Symon 1822,* 4.xi.1966, Moora Road, Grampians, ADW (fl., fr.); *Tadgell 14,* -.xii.1914, Mt. Hotham, MEL (fr.); *Tadgell 17,* -.xii.1914, Mt. St. Bernard, MEL (fl.); *Walter s.n.,* -.xi.1897, Dandenong Ranges, MEL1003640 (fl., fr.); *Williamson s.n.,* -.xii.1902, Hawkesdale, BRI080052 (fr.); *Williamson s.n..,* -.ii.1903, Hawkesdale, NSW99129 (fr.). *SOUTH AUSTRALIA: Anon. s.n.,* St. Vincents Gulf, MEL1003775 (st.); *Cleland s.n.,* 20.i.1926, Cleland's Gully, Mt. Compass, AD96803135 (fl., fr.); *Cleland s.n.,* 5.iii.1926, ca 45 km east of Cape Borda, AD96803142 (fr.); *Cleland s.n.,* 5.i.1928, Back Valley, AD96803128 (fr.); *Cleland s.n.,* 17.v.1928, Back Valley, AD96926113 (st.); *Cleland s.n.,* -.x.1929, Flinders Chase, AD96803108 (fl.); *Cleland s.n.,* 12.xii.1938, south of Second Valley Forest Reserve, AD96803117 (fl.); *Cleland s.n.,* 26.xii.1942, Upper Waterfall Gully, AD96803133 (fr.); *Cleland s.n.,* 20.i.1962, Eric Bonython Reserve, Waitpinga, AD966080099 (fr.); *Eardley s.n..* -.iii.1941, Square Waterhole, Mt. Compass, ADW4445 (fl.); *Hunt 2599,* 7.xii.1965, Penola Pine Forest Reserve, AD (fl.); *Hunt 3169,* 17.i.1970, Nangkita, AD (fl., fr.); *Ising s.n.,* 30.xii.1918, Mt. Lofty, AD966032045 (fl., fr.); *Ising s.n.,* 13.ii.1927, Mt. Lofty, AD966031950 (fl., fr.); *Kuchel 2249,* 24.ii.1965, Mt. Lofty Botanic Garden, AD (fr.) — pollen sent to Palyn. Lab. Stockholm; *Mueller s.n.,* Mount Lofty Range, MEL1003609, 1003611, 1003763 p.p. (fl.); *Orchard 1869,* 6.i.1969, Upper Waterfall Gully, AD (fr.); *Orchard 2030,* 14.ii.1969, ca 2 km east of Mount Burr, AD (fl.); *Tate s.n.,* 18.x.1879, Smithfield, AD96817165 p.p. (fl.); *Tate s.n.,* 28.x.1882, Mt. Lofty, AD96817165 p.p. (fl.); *Tate s.n.,* -.xii.1883, Mt. McIntyre, AD96926117 (fl.); *Tate s.n.,* -.x.1929, Uraidla, AD96926114 (st.); *Tepper s.n.,* 1881, Clarendon, AD96811108, MEL1003610 (fl.); *Tepper s.n.,* 6.i.1882, Square Waterhole, AD96811100 (fl.); *Tepper 410,* South Australia, AD (fl.); *Wheeler 297,* 7.xii.1966, Mount Lofty Botanic Garden, AD (fl., fr.); *Wilson 437,* 16.i.1966, ca 4 km south-west of Lake Leake, AD, CANB, CHR (fl., fr.). *TASMANIA: Archer 5,* Tasmania, NSW (fl.); *Barker 970,* 17.xi.1970, Freycinet National Park, AD (fl.); *Barker 1036,* 5.i.1971, southern side of Lake Augusta, AD (fl.); *Barker 1132,* 15.i.1971, upper slopes of Mt. Wellington, AD (fl., fr.); *Black 308,* 30.xii.1921, S. Bruny, AD (fl., fr.); *Bufton 2,* 1893, Port Arthur, MEL (fl., fr.); *Burbidge 3155,* 15.i.1949, 2 miles [3 km] from Hastings Caves Reserve, CANB (fr.); *Carolin 1662,* 2.ii.1960, Tim Shea, Florentine Valley, SYD (fr.); *Curtis s.n.,* 19.i.1911, Summit Mount Wellington, CHR180363 (fr.); *Curtis s.n.,* 19.i.1945, Mt. Wellington, HO6658 (fr.); *Curtis s.n.,* 7.ii.1947, Collins Vale track, Mt. Wellington, HO6655 (fr.); *Curtis s.n.,* 16.ii.1948, Somerset, CHR180362 (st.); *Davis s.n.,* 17.i.1937, Hente Siding near Strahan, NSW99127 (fl.); *Eichler 16631,* 15.i.1960, Cynthia Bay, Lake St. Clair, AD (fl., fr.); *Gordon s.n.,* 27.xi.1938, Blackman's Bay, HO6660 (fl.); *Gulliver s.n.,* Lake St. Clair, MEL1003619 (fr.); *Gunn 884,* 12.xii.1837, To Forest C. Hd, CGE, NSW (fl., fr.); *Gunn 884,* 31.i.1840, Mt. Wellington, NSW (fr.); *Gunn 884,* 3.xii.1841, Pt. Effingham, NSW (fl., fr.); *Hart s.n.,* -.i.1946, Launceston, HO6657 (fr.); *Hook f. s.n.,* Tasmania, UPS (fl.); *Jacobs 178,* 1960, Bicheno, MEL (fl., fr.); *Lucas s.n.,* -.xii.1923, Bellerive, NSW99138 (fl., fr.); *Lucas s.n.,* -.xii.1924, Waratah, NSW99128 (fl.); *Moore 11,* 1892, Mt. Zeehan, MEL (fl.); *Mueller s.n.,* -.i.1849, Mersey River, MEL1003621 (fl.); *Mueller s.n.,* -.i.1869, Mount Field East, MEL1003618 (fl.); *Mueller 424,* 8.i.-, Mersey R., MEL (fl.); *Mueller 887,* Brisbane Bay, Macquarie Harbour, MEL (fl.); *Phillips s.n.,* 21.xi.1965, 24 miles [38 km] from Queenstown, CBG033908 (fl.); *Phillips s.n.,* 8.xii.1965, 6 miles [10 km] from Waterhouse towards Scottsdale, CBG037168 (fl.); *Phillips & Carroll 62307,* 19.i.1962, Hartz Mountains National Park, CBG (fr.); *Rodway s.n.,* 5.x.1890, Bellerive, HO6654, 6661 (fl., fr.); *Rodway s.n.,* -.i.1893, Mt. Wellington, HO6654 p.p. (fl.); *Rodway s.n.,* -.xii.1915, Cradle Mt., NSW99126 (fl.); *Rodway 2702,* -.xii.1892, Strahan, NSW (fl.); *Rupp 45,* -.i.1922, Mt. Barron, NSW (fr.); *Somerville s.n.,* 1.i.1959, Meander R. flats, HO6652 (fl.); *Somerville 49,* Georges Bay, HO (st.); *Whaite 2214,* 19.i.1961, road to Hastings Caves, NSW (fr.). *NORTH ISLAND: Atkinson s.n.,* 31.xii.1929, Balls Clearing, WELT40783 (fl.); *Braggins s.n.,* 2.iii.1965, Taurewa, WELTU6351 (fr.); *Carse s.n.,* -.i.1898, Lake Tangonge, Kaitaia, CANTY810 (fl.); *Carse s.n.,* -.i.1901, Waimarino Plain near Haunted Whare, CANTY806 (fl.); *Carse s.n.,* -.i.1901, Kaitaia, CANTY811 (fl., fr.); *Carse s.n.,* 9.ii.1901, Waiau, CANTY809 (fl.); *Carse s.n.,* 30.iv.1906, Peria, AK5943 (fl., fr.); *Carse s.n.,* -.i.1921, nr. Waimarino, CANTY807 (fl.); *Carse s.n.,* -.xii.1925, Tauhei, Piako, CANTY808 (fl.); *Colenso s.n.,* Dannevirke, AK5945 (fl.); *Connor s.n.,* 25.ii.1946, Waiouru, CHR83986 (fr.); *Cooper s.n.,* 12.ii.1949, Mangatepopo Track, National Park, AK24230 (fl.); *Cooper s.n.,* 26.xi.1949, south of Miti Miti, AK35678 (fl.); *Court et al, s.n.,* 19.viii.1973, Slipper Island off Tairua, AK133139 (st.); *Cranwell s.n.,* 17.i.1932, Tikitere, AK100952 (fr.); *Cranwell s.n.,* 21.iv.1934, Willoughby's, Rukuhia, AK101096 (st.); *A. Cunningham 85 (531),* 1826, Wangaroa, K (fl., fr.) — holotype of *G. depressus*; *R. Cunningham 530,* 1834, Keri Keri, K (fr.) — holotype of *G. citriodorus*; *Davey s.n.,* -.xii.1943, Paekakariki, CHR37228 (fl., fr.); *Druce s.n.,* -.i.1960, betw. Egmont & Ponaki Rd., CHR86699 (fl.); *Druce s.n* -.xi.1967, Taita, CHR179599 (fl.); *Druce s.n.,* -.ii.1968, Puna Teao Clearing nr. Waikare-iti, CHR180597 (fr.); *Druce s.n.,* -.xii.1970, Taraponui, Maungaharuru Ra., CHR216819 (fl.); *Edwards s.n.,* -.xii.1949, Henderson Valley, AK31859 (fr.); *Hamlin s.n.,* 23.iv.1949, Dobson's Ridge, Tararua Mtns., CHR65944 (fr.); *Hamlin s.n.,* 18.i.1950, near Pureora, CHR68631 (fr.); *Hamlin s.n.,* 21.ii.1955, Holly Flat Swamp, Mount Egmont, WELT2258 (fr.); *Harris s.n.,* 7.vii.1944, Mangaroa, Wallaceville, CHR70014, (st.); *Hill s.n.,* Tarawera between Napier & Taupo, AK13345 (fl.) — isotype of *Haloragis minima*; *Hodgkins s.n.,* 1930, Tongariro, AK100924 (st.); *Hynes s.n.,* 9.i.1958, Cutty Grass Track, Waitakeres, AK50834 (fl.); *Hynes s.n.,* 20.ii.1970, Ruapani Lakes, Waikaremoana, AK122685 (fr.); *Kirk s.n.,* Auckland, AK11476 WELT40769, 40770 (fl.); *Kirk s.n.,* Takapuna, CANTY726 (fl., fr.); *Mason s.n.,* 24.xii.1939, base of Mt.

Holdsworth, CHR23329 (fl.); *Mason s.n.*, 13.i.1940, base of Mt. Holdsworth, CHR23402 (fl., fr.); *Mason 7466,* 4.xii.1959, betw. Piako River & Patetonga, CHR (fl., fr.); *Mason 7505,* 5.xii.1959, 3 miles [5 km] S.E. of Tirohia, CHR (fl., fr.); *Mason 7744,* 11.xii.1959, 6 miles [10 km] N. of Katikati, CHR (fl., fr.); *Mason & Esler 11333,* 21.xi.1970, Baylys Basin Road, W. of Dargaville, CHR (fl.); *Mason & Esler 11403,* 23.xi.1970, Taharoa Lake, CHR (fl.); *Mason & Moar 202, 202a,* 26.xi.1949, Marumaru Swamp, CHR (st. — terat.); *Mason & Moar 6416,* 26.xi.1958, 1 mile [2 km] from Netherby, CHR (fl., fr.); *Mason & Moar 6481,* 27.xi.1958, lake at western end of Rukuhia Swamp, CHR (fl., fr.); *Mason & Moar 6757,* 6.xii.1958, Te Mimiha Swamp, CHR (fl.); *Matthews s.n.*, Waimarino Plain, WELT40825 (fl., fr.); *Matthews s.n.*,-.iii.1907, Kaitaia, AK5944 (st.); *Matthews 1127,* 2.i.1924, Ohaupaupau near Ruapehu, AK (fl., fr.); *McKay s.n.*, Mt. Rochfort, CHR60225 (fr.); *Meebold 18235,* -.ii.1933, Ruapehu, M (fl., fr.); *Meebold 18236,* -.xii.1932, Makoraro, Ruahine, M (fl.); *Moar s.n.*, 21.xii.1948, Mangaroa, Wallaceville, CHR70074 (fl.); *Moar 544,* 1.ii.1950, Lake Kuwakatai, CHR (st.); *Moore s.n.*, 27.xii.1953, Okaihau-Kapo, CHR 83626 (fl., fr.); *Oliver s.n.*, 8.iv.1917, Otumakokori, side of Boiling River, WELT6886 (st.); *Oliver s.n.*, 7.ii.1942, Rimutaka Ra., WELT6885 (fr.); *Oliver s.n.*, 29.i.1954, Waimarino, WELT 39444 (fl., fr.); *Orchard 3922,* 21.i.1973, Upper Kauaeranga Valley, AK (fr.); *Orchard 4083,* 9.x.1973, Pukatea Ridge Track, Puketi State Forest, AK (fl.); *Petrie s.n.*, 30.i.1916, Waiouru, WELTU2662 (fr.); *Petrie s.n.*, -.i.1917, Waimarino plain, WELT40771, 40830 (fl., fr.); *Petrie s.n.*, -.i.1920, Te Whaiti, WELT40829 (fl., fr.); *Petrie s.n.*, -.iii.1921, Waimarino Plain, CHR11352 (fr.); *Petrie s.n.*, 16.i.1922, Dimphail, Te Akatea, WELT (fl.); *Potts s.n.*, 11.xii.1954, Desert Rd., National Park, cult. Opotiki, CHR87710 (fl.); *Simpson s.n.*, 25.xii.1955, Lake Rotoma, CHR95518 (fl.); *Steele s.n.*, -.iii.1966, Taurewa, WELTU2661 (fr.); *Sutherland s.n.*, -.ii.1935, S.E. of Orakei-koraka, WELT40787 (fl., fr.); *Wood s.n.*, 2.i.1969, Lake Ruapani, AK120587 (fl.); *Zotov s.n.*, 21.xii.1943, Reporoa bog, CHR41578 (fl.). *SOUTH ISLAND: Bannister s.n.*, 18.xi.1952, Pupu Pinelands, Takaka, CHR92462 (st.); *Barker 355,* 4.i.1938, Tekapo River township, CHR21009 (fl., fr.); *Burrows s.n.*, -.i.1954, Hoophorn Ridge, Ben Ohau Ra., CANU3175 (st.); *Burrows s.n.*, -.i.1957, Craigieburn Ra., CANU3176 (fl.); *Burrows s.n.*, 1958, Kettlehole, Cass, CANU3177 (fr.); *Burrows s.n.*, -.i.1962, Eglinton Valley, CANU5670 (fl., fr.); *Burrows s.n.*, -.ii.1962, near Kumara, CANU5734 (fr.); *Burrows s.n.*, 10.ii.1971, L. Thomas, CANU014747 (fl., fr.); *Cheeseman s.n.*, -.i.1881, Lake Rotoiti, Nelson, AK5946 (fl., fr.); *Cheeseman s.n.*, -.i.1886, Mt. Arthur plateau, AK5946 p.p. (fl., fr.); *Connor s.n.*, 11.ii.1961, 3 miles [5 km] N. of "The Chimneys", Mararoa Catchment, CHR122559 (fr.); *Connor & Macrae s.n.*, 19.xii.1962, Jack's Stream Fan, Ferintosh, CHR173388 (fl.); *Degener & Degener 32631,* 21.i.1969, Mt. Sebastopol, BISH (fl., fr.); *Dobson s.n.*, 29.xii.1970, Gouland Downs, Nelson, CANU014484 (fl.); *Dobson s.n.*, 3.ii.1971, Te Anau, CANU014620 (fl., fr.); *Dobson s.n.*, 10.ii.1971, Lake Thomas, CANU014707 (fl., fr.); *Gibbs 406,* -.iii.1905, Para Para, Golden Gully, CHR (fr.); *Hair s.n.*, 26.v.1955, Molesworth, CHR87621 (st.); *Harman s.n.*, 2.i.1946, L. Rotoiti, Nelson, CHR70119 (fl.); *Hay s.n.*, 1.vi.1951, above Bainham, Aorere River, CHR73719 (st.); *Hay s.n.*, 1.i.1952, Paramahoe, Takaka, CHR73660 (fl., fr.); *Healy s.n.*, 24.xii.1935, Okaramio, CHR33974 (fl., fr.); *Healy s.n.*, -.i.1940, Okaramio, CHR 35542 (fl., fr.); *Healy s.n.*, 5.iii.1944, Lower Moutere Hills, CHR44752 (fl., fr.); *Heine s.n.*, 30.xii.1933, Mt. Arthur, WELT40786 (fr.); *Hynes s.n.*, 28.i.1965, Jack's Pass, above Hanmer, AK106124 (fr.); *Hynes s.n.*, 24.ii.1969, West Bay, Lake Rotoiti, AK120241 (fl., fr.); *Johnson s.n.*, 3.xii.1969, Mahara No. 7, Manapouri, OTA028320 (st.); *Johnson s.n.*, 12.i.1970, near Buncrana I., Lake Manapouri, OTA028491 (fl.); *Johnson s.n.*, 20.v.1971, Worsley delta, Lake Te Anau, OTA031124 (st.); *Kirk 64,* Nelson, AD, CGE, OTA (fl., fr.); *Laing s.n.*, Ada Valley, CANU3171 (st.); *Laing s.n.*, Mt. Potts, CANU3183 (fl.); *Locan s.n.*, 2.ii.1969, Invercargill, CHR186100 (fr.); *Lister s.n.*, -.ii.1889, between Lakes Tekapo & Pukaki, CGE (fr.); *Lloyd s.n.*, 29.iii.1958, above Woodbank Station, Hanmer, CANU3128 (fr.); *Lloyd 7257,* 4.vi.1972, L. Tekapo, N.W. side of Mt. John, CANU (st.); *Lloyd 65143,* -.ii.1965, Cass, CANU (fr.); *Lloyd 66082,* 27.i.1966, Waitaha R., CANU (fr.); *Lloyd 67723,* 10.xii.1967, Old Man Rock, road to Westhaven Inlet CANU (fl.); *Macmillan s.n.*, 30.xii.1962, Mt. Cook Station, S. Liebig Range, CHR193893 (fl., fr.); *Macmillan 68/10,* 6.i.1968, Irishman Creek, CHR (fl.); *Macmillan & Chapman s.n.*, 19.xii.1970, Ferintosh Stn., Lake Pukaki, CHR217737 (fl.); *Macmillan & Chapman s.n.*, 19.xii.1970, Tasman River bed, Lake Pukaki, CHR217751 p.p. (fl.); *Macmillan & Mitchell s.n.*, 3.iii.1970, Irishman Creek Stn., Lake Pukaki, CHR206766 (fr.); *Mark s.n.*, 30.i.1962, Maungatua, OTA007126 (fr.); *Mason 8122,* 3.i.1961, Ferguson Creek, Hunter Valley, CHR (fl., fr.); *Mason & Chapman 12660,* 22.ii.1973, Old Man Swamp, 12 miles [19 km] E. of Lake Manapouri, CHR (fr.); *Mason & Moar 1043,* 18.ii.1952, Clinton-Mataura road, CHR (fr.); *Mason & Moar 5383,* 18.ii.1958, Lake Kini, Bruce Bay, CHR (fl., fr.); *Melville 6034,* 14.i.1962, Cobb River, below Mt. Peel, CHR (fl., fr.); *Melville 6496,* 22.ii.1962, Glen Ure Stn., E. of Dipton, CHR (fr.); *Molloy s.n.*, 30.i.1970, Eyrewell Scientific Reserve, CHR201679 (fr.); *Moore s.n.*, -.i.1940, Bluff Hill summit, CHR28041 (fl.); *Moore s.n.*, 5.i.1947, Collingwood, CHR80831 (fl.); *Morrison s.n.*, western part of Amuri Co., WELT (fl.); *Oliver s.n.*, 26.xii.1923, Mt. Holdsworth, WELT6884 (fl.); *Oliver s.n.*, 6.iii.1927, Lake Manapouri, WELT40779 (fr.); *Oliver s.n.*, -.ii.1946, Salisbury Tableland, WELT6871 (fl., fr.); *Oliver s.n.*, 19.iv.1948, Mawheraiti, WELT6864 (st.); *Oliver s.n.*, 1.iii.1949, Charleston, WELT6865 (fr.); *Oliver s.n.*, 1.i.1950, Collingwood, WELT6899 (fr.); *Petrie s.n.*, Mt. Arnold, Lake Hawea, WELT40796 p.p. (st.); *Petrie s.n.*, Catlins river, WELT40827 (fl.); *Petrie s.n.*, Signal Hill, Dunedin, WELT40826 (fl., fr.); *Petterson s.n.*, -.ii.1951, Takaka, CHR73717 (fl., fr.); *Petterson s.n.*, -.xii.1952, West Wanganui Inlet, CHR77835 (fr.); *Philipson s.n.*, 7.xi.1956, Sarah, CANU285 (st.); *Philipson s.n.*, 7.i.1957, Waterfall Creek, Cass, CANU282 (fl.); *Philipson s.n.*, 7.i.1957, Pylon Gully, Cass, CANU283 (fl.); *Schweinfurth 711,* 23.ii.1959, Crooked Reach, E. of Frazer Peaks, Stewart Island, M (fr.); *Simpson s.n.*, -.i.1944, Lake Manapouri, CHR92809 (fl., fr.); *Simpson s.n.*, 4.i.1949, L. Manapouri, CHR205002 (fr.); *Simpson 4867,* 8.xii.1965, Cape Farewell, CHR (fl.); *Simpson 4928,* 25.i.1966, Butler River, CHR (fl., fr.); *Sykes 104/69,* 20.ii.1969, near Collingwood, CHR (fr.); *Thomson s.n.*, -.xii.1879, near Dunedin, BRI080066 (fl., fr.); *Wardle s.n.*, -.i.1953, Moke Swamp, Otago, OTA003541 (fl., fr.); *Wardle s..n,* 15.i.1966, Skiffington Swamp, Fox, CHR166582 (st.); *Wardle s.n.*, 26.ii. 1970, Okarito Spit, CHR 195159 (fr.); *Wardle s.n.*, 1.xii.1970, between The Forks and Okarito, CHR214819 (fl.); *Zotov s.n.*, 5.i.1936, Dart River, CHR9990 p.p. (fl., fr.); *Zotov s.n.*, 17.i.1938, Oreti River, CHR20581 (fl., fr.).

Several species described since Schindler's revision seem (ex descr.) to be only minor variants of this species, but no material was available for comparison in this study. *Goniocarpus rubricaulis* Griffith (1854), *Haloragis paucidentata* Hosokawa (1940) and *H. walkeri* are particularly of note in this respect, and probably should be referred to *G. micranthus* subsp. *micranthus*.



Figs. 303-306. *Gonocarpus micranthus*. 303, 304. subsp. *micranthus*. 303. Habit (from *Orchard 2015*). 304. Flower (from *Eichler 16631*). 305, 306. subsp. *ramosissimus*. 305. Habit. 306. Flower. (figs. 305, 306 from *Boyd s.n.*, AD95809056). Scales represent 1 cm (figs. 303, 305) or 1 mm (figs. 304, 306).

A number of collections of subsp. *micranthus* from the Highlands of Papua New Guinea (e.g. *Flenley ANU2170, Hoogland & Schodde 7479, Robbins 266, 382, Vink 17289, Walker ANU631*) have abnormally narrow leaves that are lanceolate or narrow-lanceolate instead of orbicular to ovate. Other collections from similar habitats nearby are normal in this respect.

subsp. **ramosissimus** Orchard, subsp. nov.

Herba erecta (20-) 30-40 (-75) cm alta; folia ovata ad cordata 1.0-1.3 cm longa, 0.8-1.1 cm lata, ± sessilia serrata dentibus 15-25 crenulatis. Inflorescentia diffusa, ramosa quater, ramuli ultimi ± horizontales. Holotypus: A. E. Orchard 2383, 27.x.1969, New South Wales, Evans Head, on coast ca 135 km north of Coff's Harbour. Growing on black sand on sandy heath, AD97016109 (fl., fr.)! Isotypi: AK, B, BRI, C, CANB, FI, K, L, LE, M, MEL, NSW, NY, P, PE, PR, S, SI, TI, UC, US, W.

Goniocarpus rotundifolius Drake, in Rees, Cyclop, 16 (1811), nec *Haloragis rotundifolia* Benth. (1864) [Typus: "Gathered near Port Jackson, New South Wales, by John White, M.D." Holotypus: n.v.]

Goniocarpus microcarpus Thibaud ex DC., Prod. 3 (1828) 66 [Typus: "in Australasia, herb. Thibaud". Holotypus: *Thibaud s.n.*, ex Australasia, G-DC (fl.) (photo!).].

Erect herb, stems rooting at nodes in lower part only (20-) 30-40 (-75) cm tall (Fig. 305); leaves ovate to cordate, 1.0-1.3 cm long, 0.8-1.1 cm wide, ± sessile, serrate with 15-25 small crenate teeth. Inflorescence diffuse, branching to the 4th order, final branchlets ± horizontal. Flowers and fruits as for species, but ribs of fruit often tuberculate, the tubercles sometimes bearing a short, curved unicellular hair.

Distribution: This subspecies is confined to the coastal regions of northern New South Wales and southern Queensland (Fig. 301).

Ecology: *G. micranthus* subsp. *ramosissimus* is usually found on flat swampy heaths in sandy soils ("wallum"). Collectors' notes include "sandy swampy soil (Wallum Country)" (*Kajewski 19*); "in open Eucalypt forest on shallow sandy soil" (*Johnson 1101A*); "Soil: yellow podsolic from granite. Eucalypt forest" (*Boyd AD95809056*); "damp, heavy soil in *Melaleuca* scrub" (*Burgess CBG015871*); and "swamp behind sanddunes of beach" (*Rodway 148*). Flowering normally occurs between October and March and fruiting from November to May.

Specimens examined:

QUEENSLAND: Bailey s.n., -.iv.1879, Brisbane river, BRI080061 (st.); *Bailey s.n.*, -.iii.1889, Sunnybank, Brisbane, BRI080050 (fl.); *Bailey s.n.*, 20.ii.1891, Stanthorpe, BRI080051 (fl.); *Baxter & Lebler 1126*, 3.x.1968, about 2 miles [3 km] S. of Tewantin on Eumundi road, BRI (fl., fr.); *Blake 2277*, 27.ii.1931, Lawnton, BRI (fl. — terat.); *Bick s.n.*, -.ii.1915, Chernside, NSW99131 (fl.); *Dietrich s.n.*, 1863 - 1865, Brisbane River, BRI080055 (fl.); *Eichler 13138*, 13.xi.1956, near Caboolture, at King John Creek, AD, AK (fl.); *Epps s.n.*, -.xii.1919, Fraser Island, BRI080063 (fl.); *Hartman 13*, 1873, Severn, MEL (fr.); *Henderson et al. 725*, 20.iv.1971, Blackdown Tableland, ca 32 km S.E. of Blackwater, AD, BRI (fl., fr.); *Hubbard 4631*, 17-18.x.1930, Fraser Island, BRI (fl.); *Johnson 969*, 19.ix.1959, Blackdown Tableland, 12 miles [19 km] S.S.W. of Bluff - Two Mile Creek, BRI (fl.); *Johnson 1101A*, 22.ix.1959, Blackdown Tableland, BRI (fl., fr.); *Kajewski 19*, 18.i.1928, mainland opp. S. end of Fraser Island, BRI (fl., fr.); *Smith 353*, 15.ii.1938, Sunnybank, BRI (fl.); *Smith 688*, 29.xii.1939, about 17 miles [27 km] S.W. of Bundaberg, BRI (fl.); *Smith 776*, 29.i.1940, Racecourse Creek, N.E. of Wallangarra, BRI (fl.); *van Royen 10057*, 24.ix.1965, road from Beerum to Caboolture, BISH (fl., fr.); *Ward s.n.*, 11.ii.1959, Redlands Experiment Station, Moreton district, BRI1015672, CANB79393 (fl., fr.); *Whaite 3038*, 6.i.1966, ½ mile [1 km] south of Point Cartwright turnoff, NSW (fl.); *White s.n.*, -.iv.1907, Virginia Creek, PR530027 (fr.); *White s.n.*, 13.iv.1907, Nudgee, Brisbane, BRI080049 (st.); *White s.n.*, -.xii.1913, Nerang, BRI080046 (fl.); *White s.n.*, 17.iii.1916, Wellington Point, BRI080053 (fl., fr.); *Williams s.n.*, -.iii.1967, Caloundra, BRI080982, 080983 (fl.); *Williams s.n.*, 5.x.1970, Bribie Island, BRI103159 (fl.). *NEW SOUTH WALES: Anon. s.n.*, Clarence River, MEL1003604 (fl.); *Anon. s.n.*, Port Jackson, AD96906001 p.p.; *Baudin s.n.*, 1801, Blue Mountains, P (terat.); *Beckler s.n.*, Ben Lomond, MEL1003592 (fl.); *Beckler s.n.*, R. Hastings, MEL1003594 (fr.); *Beckler s.n.*, 1884, Clarence River, M (fl., fr.); *Betche s.n.*, -.xii.1886, near Sydney, NSW99160 (fl.); *Blakely s.n.*, 30.iii.1918, Carr's Paddock, Carlton, NSW113147 (fr.); *Blakely & Shiress s.n.*, 20.iv.1935, Gosford, NSW99155 (fr.); *Boorman s.n.*, -.xii.1909, Dorrigo, NSW99147 (fl.); *Boorman s.n.*, -.i.1911, Torrington, NSW98929 (fl.); *Boyd s.n.*, 24.i.1955, Snowy Range, New England, AD95809056 (fl.) — pollen sent to Palyn. Lab. Stockholm; *Brown 4426*, Port Jackson, K (fl.); *Brown s.n.*, Port Jackson, MEL 1003608 (fl.); *Burgess s.n.*, 23.ii.1963, Limeburner's Creek near Booral, CBG015871 (fl.); *Burgess s.n.*, 1.xi.1966, Coff's Harbour, CBG018739 (fl.); *Burgess s.n.*, 6.v.1970, Red Rock, CBG037235 (fl., fr.); *Caley s.n.*, N'elle Hollande, G (fl.); *Cleland s.n.*, Neutral Bay, AD96905116 (fl., fr.); *Cleland s.n.*, 24.iv.1912, Grafton, AD96905160 (fr.); *Cleland s.n.*, 30.ix.1912, Byron Bay, AD96905115 (fl., fr.); *Constable s.n.*, 22.i.1956, Wingello State Forest, NSW35339 (fl.); *Constable s.n.*, 25.iii.1962, Tent Hill-Torrington road, NSW66214 (fl., fr.); *Constable 6696*, 22.xii.1965, Marley Lagoon, Royal National Park, NSW (fl., fr. — terat.); *Constable 7375*, 20.vi.1967, Bona Park, Sans Souci, NSW (fr.); *Crawford 526*, -.iii.1885, Moona, Walcha, MEL (fl., fr.); *Dwyer 1082*, -.iii.1920, Belmont, NSW (fr.); *Evans s.n.*, 20.ii.1926, Narrabeen, SYD (fl., fr.); *C.J.F. s.n.*, New England, MEL1003601 (fl.); *Field s.n.*, NSW, BRI080047 (fl.); *Fletcher s.n.*, 30.iv.1887, Botany Bay, NSW99157 (fr.); *Fletcher s.n.*, 3.iii.1888, Alexandria Swamps, NSW99159 (fl., fr.); *Gauba s.n.*, 7.iii.1952, Jervis Bay, CBG015104 (fl., fr.); *Hickey s.n.*, -.iii.1885, Maryland, MEL1003593 (fl.); *Hynes s.n.*, -.i.1903, Randwick Rifle Range, NSW99158 (fl.); *Jessup & Gray 345*, 8.xii.1953, Gilgai, New England, CANB (fl.); *Johnson s.n.*, 19.iv.1953, Mellong Range, NSW99165 (fr.); *King s.n.*, New Holland, G (herb. Deless.) (fl., fr.); *Lithgow 141*, 11.iv.1965, Nelson Bay, NSW

(fr.); *Mair & Constable s.n.*, 8.xi.1950, Waterfall, NSW16107 (fl.); *Martenz Q110*, 23.v.1968, Port Macquarie, CANB (fr.); McBarron 8783, 27.i.1964, Picton Lakes, Thirlmere, NSW (fl., fr.); *McGillivray 2064A*, 28.vi.1966, 8 5 miles [13.5 km] directly S.S.W. of Evans Head, NSW (st.); *Meebold 2642*, -.ii.1929, Long Bay, M (fl.); *Mueller s.n.*, Ben Lomond, MEL1003607 (fl.); *Noonan s.n.*, -.iii.1949, Glen Innes, NSW98930 (fl., fr.); *Orchard 2383*, 27.x.1969, Evans Head, AD (fl., fr.) — holotype of *G. micranthus* subsp. *ramosissimus*; *Orchard 2386*, 28.x.1969, ca 6 km south of Coff's Harbour, AD (st.); *Rodway 148*, 25.x.1930, Huskisson, NSW (fl.); *Salasoo 1043*, 4.i.1953, Narabeen, NSW (fl.); *Thomas s.n.*, -.xii.1912, Inverell, NSW99105 (fl.); *White s.n.*, New South Wales, G (herb. Deless.) (fl., fr.); *White-Haney s.n.*, 24.ii.1930, Glen Elgin, CANB7214 (fl.).

The specimen in P here cited as holotype of *Haloragis tenella* Brongn. bears the inscription "Ad. Brongniart scpt." As the specimen is a very good match with t. 68 of the original publication, there is no reason to doubt that this is in fact type material.

The type material of *Goniocarpus depressus* A. Cunn. in K, although very poor, undoubtedly represents *G. micranthus*. However, J. D. Hooker (1852) confused *G. depressus* with the Tasmanian species *G. serpyllifolius*. *G. serpyllifolius* was also for a time confused with the New Zealand species *G.* ('*Haloragis*') *aggregatus* (and its later synonyms). When the New Zealand and Australian species were finally recognised as distinct, the epithet '*serpyllifolius*' was used for the Tasmanian plants, and '*depressus*' was retained for the New Zealand ones. The misapplication of the name *Haloragis depressa* to the New Zealand species *G.* ('*Haloragis*') *aggregatus* has occurred even in very recent accounts of the genus due, no doubt, to the poor quality of the type and its relative inaccessability to New Zealand botanists.

The two subspecies can usually be readily distinguished by the broader, more diffuse inflorescence, larger leaves and more erect habit of subsp. *ramosissimus*, although some specimens, particularly if sterile, are difficult to place. Subspecies *ramosissimus* is confined to New South Wales and Queensland, although three collections by A. Morrison in 1892 (BRI003488, 078858 and AD95808017) bear labels with the locality "Oakley, Victoria" mentioned. No other collections of this subspecies are known from Victoria, and these records are therefore here considered as of doubtful origin.

The epithet "ramosissimus" refers to the inflorescence, the most distinctive feature of the new subspecies.

29. **Gonocarpus cordiger** (Fenzl) Endl. ex Nees (Figs 307-309)

Gonocarpus cordiger (Fenzl) Endl. ex Nees, in Lehm., Pl. Preiss. 2 (1848) 225, 226 ['Goniocarpus'].

Haloragis cordigera Fenzl in Endlicher et al., Enum. Pl. Hueg. (1837) 45 [Typus: "Swan River. (Hugel)". n.v.] Walp., Rep. 2 (1843) 99; Hooker, Ic. Pl. 6 (1843) pl. 548; Endl. ex Nees in Lehm., Pl. Preiss. 2 (1848) 226 ['*Haloragis cordata*'] pro basionym *Gonocarpus cordiger*; Benth., Fl. Aust. 2 (1864) 476; F. v. M., Census 1 (1882) 49, Sec. Census 1 (1889) 85; F. v. M., Trans. R. Soc. Vict. 24 (1888) 133; Diels & Pritzel, Bot. Jb. 35 (1904) 447; Schindler, Pflrch 23 (1905) 37; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 466; Praglowski, Grana 10 (1970) 172.

Loudonia cordigera (Endl.) Hereman, Paxton's Bot. Dict. (1868) 344.

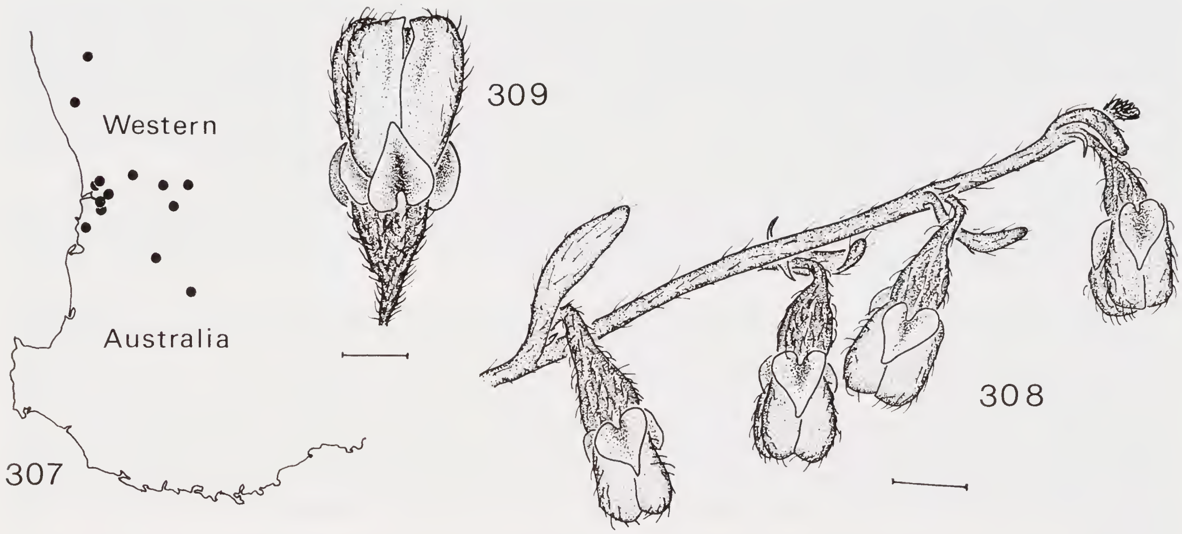
Figs.: Hooker, Ic. Pl. 6 (1843) pl. 548; Schindler, Pflrch 23 (1905) fig. 10A-C; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 466.

Perennial herb or small sub-shrub 30-45 cm tall, stems decumbent or ascending, $\pm$ 4-ribbed longitudinally, sparsely pilose with spreading, transparent, 2-celled hairs 0.8-1.0 mm long.

Leaves all alternate, sessile, linear to terete, 1.5-3.5 cm long, 0.8-1.0 mm wide, entire, margins revolute, apex acute, sparsely pilose with hairs as for stems.

Inflorescence an indeterminate spike of flowers borne singly in the axils of alternate primary bracts. Lateral spikes are borne in the axils of the upper leaves. Primary bracts leaflike, 0.2-0.7 mm long, becoming smaller in upper part of spike, $\pm$ glabrous, occasionally with 1-2 hairs on margins; secondary bracts brown, membranous, ovate, 0.4-0.6 mm long, 0.3-0.4 mm wide, margin irregular (Fig. 308).

Flowers 4-merous, on a pedicel 1 mm long (Fig. 309). Sepals 4, yellow-green, cordate, 1.3-1.4 mm long, 1.1-1.2 mm wide, attached only in centre base, auricles extending $\frac{1}{2}$-$\frac{2}{3}$ of ovary length, margins minutely crenate or serrulate, glabrous. Petals 4, yellow-green, hooded, becoming reflexed between the sepals after anthesis, (2.0-) 2.4-2.5 mm long, 0.6-0.7 (-1.0) mm wide (keel to margin), glabrous except for 1-2 rows of 2-3-celled hairs 0.3-0.4 mm long on the keel. Stamens 8, filaments 0.2 mm long; anthers yellow-orange, linear-oblong, 1.9-2.1 mm long, 0.3 mm wide, nonapiculate. Styles 4, yellow, stigmas red, oblong, closely pressed together in bud, becoming orange, fimbriate and globular in flower. Ovary slate-grey to red, obconical, 1.0-1.3 mm long, 0.8-1.0 mm diam., 8-ribbed longitudinally, irregularly verrucose with a 2-3-celled hair 0.3-0.4 mm long atop each wart, incompletely 4-locular, septa spongy, 4 pendulous ovules of which only 2 are functional, and only 1 develops to seed. Mature fruit not seen, immature fruit as for ovary.



Figs. 307-309. *Gonocarpus cordiger*. 307. Distribution. 308. Upper part of inflorescence. 309. Flower. (figs. 308, 309 from *Pritzel 145*). Scales represent 1 mm (figs. 308, 309).

DISTRIBUTION: *G. cordiger* is confined to the Darling Ranges near Perth, in Western Australia, most collections coming from within 100 km of that city. Isolated collections have also been made from near Moora (*Royce 4926*) and Narrogin (*Steward 264*) (Fig. 307).

ECOLOGY: Very little information exists concerning the habitat in which this species grows. *Pritzel 145* records it as growing "in silvis subumbrosis" and *Burbidge 7902* from "regrowth on recent burn under Jarrah/Marri forest on sandy soil." Most of the collection locations occur between the altitudes of 300-600 m. Flowering takes place from (August-) October to December (-February) and fruiting from December onwards.

SPECIMENS EXAMINED:

WESTERN AUSTRALIA: Anon. 186, -.x-xi.19.., Avon District, PERTH (fl.); *Andrews XLV*, 23.xi.1901, near Guildford, PERTH (fl.); *Burbidge 7902*, 23.xii.1971, Pingelly-Wandering road, CANB (fl.); *Drummond 83, 4th coll.*, 1848, Swan River, CGE, MEL, NSW, P (fl., fr.); *Fitzgerald s.n.*, -.xi.1902, Bayswater, NSW98951 p.p. (fl.); *Fitzgerald s.n.*, -.xii.1902, Midland Junction, NSW98965 (fl.); *Gardner s.n.*, -.xii.1920, Armadale, PERTH (fl.); *Gardner 7486*, 19.x.1944, North of Greenhills, PERTH (fl.); *Hamilton s.n.*, 1902, W.A., NSW98967 (fl.); *Koch 1675*, -.xi.1906, Darling Range, AD, NSW p.p. (fl.); *Koch 1675*, xii.1906, Wooroloo, MEL (fl.); *Meebold 6732*, -.xii.1929, Mogumber, M (fl.); *Meebold 7398*, -.xii.1929, Darling Range, M (fl.); *Morrison s.n.*, 18.xi.1899, Smith's Mill, Darling Range, BRI085972 (fl.), CANB136630 (fl.); *Morrison s.n.*, 19.i.1899, Kelmscott, Canning River, CANB136633 (fl.); *Morrison s.n.*, 22.xii.1900, Smith's Mill, Darling Range, BRI079990, CANB136631 (fl.); *Mueller s.n.*, Serpentine River, MEL1003478 (fl.); *Mueller s.n.*, -.xi.1877, south of Swan River, MEL1003480 (fl.); *Mueller s.n.*, -.xi.1877, towards Yorke, MEL1003476 (fl.); *Mueller s.n.*, -.xi.1877, Swan River, Darling Range, MEL1003477, 1003479 (fl.); *Preiss 851*, near Cataract, CGE (fr.); *Preiss 1223*, -.i.1840, Swan River, G (herb. DC.), HBG, MEL, P, W (fl., fr.); *Pritzel 145*, -.xii.1900, Darling Range, AD, M, NSW, P, PERTH, PR (fl.); *Royce 2535*, 13.i.1948, Leamurdie, eastern suburb of Perth, PERTH (fl.); *Royce 4926*, 3.xi.1954, 20 m. [32 km] W. of Moora, PERTH (fl.); *Sewell s.n.*, 1884, Upper Swan River, MEL1003472 (fl.); *Speck s.n.*, Armidale, UWA487 (fl.); *Steward 264*, -.ii.1913, Narrogin, NSW (fl.); *Tepper 66*, -.x-xi.1892, Beverley, MEL1003700 (fl.).

Occasional plants have been collected which have glabrous stems and leaves and almost glabrous ovary and petals (e.g. *Gardner 7486* (PERTH), *Koch 1675* (AD)).

The flowers are usually single in the axil of the primary bracts, as is normal in *Gonocarpus*, but a collection by Hamilton (NSW98967) has some flowers in groups of 2-3 in the axil of a primary bract, ± arranged in a mono- or dichasium. In these instances, tertiary bracts, similar to, but smaller than the secondary bracts, are present.

30. **Gonocarpus pithyoides** Nees (Figs. 310, 311)

Gonocarpus pithyoides Nees in Lehm., Pl. Preiss. 2 (1848) 225 ("Goniocarpus") [Typus: "In arenosis silvae prope urbiculam Perth Novembri a. 1839. Herb. Preiss. No. 1224." Holotypus: *L. Preiss 1224*, 28.xi.1839, In arenosis silvae prope urbiculam "Perth", Lem. num. 1224, LE (fl., fr.)! Isotypi: *Preiss 1224*, -.xi.1839, In

arenosis silvae urbiculam Perth, P!, W333985 p.p. (fr.)!; *Preiss 1224*, Australasia, W (3 sheets: 148959, 334037, no number) (fl., fr.)!; *Preiss 1224*, West Australia, M!, PR! (fl., fr.); *Preiss 1224,* 1837-1840 and 1843, Swan River, G (herb. Boiss. & herb. DC.) (fl., fr.); *Preiss 1224,* MEL39216 (fl., fr.)!].

Haloragis pithyoides (Nees) Benth., Fl. Aust. 2 (1864) 476; F. v. M., Census 1 (1882) 49; F. v. M., Trans. R. Soc. Vict. 24 (1888) 137; F. v. M., Sec. Census 1 (1889) 85; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 30; Schindler, Pflrch 23 (1905) 37; Ostenfeld, K. danske Vidensk, Selsk., Biol. Medd. 3 (1921) 99 ["pithyroides"]; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 466; Praglowski, Grana 10 (1970) 172.

Figs.: Schindler, Pflrch 23 (1905) fig. 11 A-B; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 466.

Erect perennial herb 20-40 cm tall; rootstock a simple taproot; stems slender, green, not or very weakly ribbed, branching only at base, glabrous.

Leaves alternate (sometimes subopposite at base), sessile, terete or sometimes slightly flattened, (0.6-) 1.0-1.5 cm long, 0.5-1.0 mm diam., acute at tip, sometimes slightly channelled above, otherwise veins obscured, margins entire, glabrous or scabrous with very sparse semi-appressed hairs.

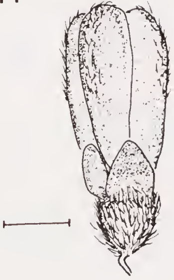
Inflorescence an indeterminate spike of flowers borne singly in the axils of alternate primary bracts. Lateral inflorescences arise in the axils of the upper leaves. Primary bracts green, fleshy, linear to terete, (2.0-) 3.0-4.5 mm long, 0.4-0.6 mm wide, entire, not ribbed, glabrous. Secondary bracts (bracteoles) brown, membranous, lanceolate, 0.5-1.0 mm long, 0.2-0.25 mm wide, entire, glabrous.

Flowers 4-merous, drooping on pedicels 0.5 mm long (Fig. 311). Sepals 4, reddish, broad-ovate to deltoid, 0.6-0.8 mm long, (0.6-) 0.8-1.0 mm wide, subcordate and somewhat swollen at base, tip acute, glabrous. Petals 4, yellow to reddish, hooded, keeled, shortly unguiculate, 2.0-2.3 mm long, 0.6 mm wide, glabrous, or scabrous on keel. Stamens 8, filaments 0.2-0.3 mm long; anthers yellow to reddish, linear-oblong, 1.4-1.7 mm long, 0.2-0.3 mm wide, 4-locular, nonapiculate, antisepalous anthers ca 0.2 mm longer than antipetalous ones. Styles 4, clavate, 0.3 mm long; stigmas red, capitate, fimbriate. Ovary grey, turbinate, 0.5-0.8 mm long, 0.8-0.9 mm wide, 8-ribbed, otherwise smooth, glabrous or scabrous, often with a tuft of hairs at top of pedicel/base of ovary, incompletely 4-locular, 1 ovule per locule.

Fruit drooping, on pedicel 0.6-0.7 mm long, dark-grey, turbinate, 0.7-0.8 mm long, 0.8-0.9 mm wide, 8-ribbed, smooth between ribs; sepals persistent, erect, ± enclosing styles, deltoid to cordate, 0.7-0.8 mm long, 0.6-0.8 mm wide, ± swollen at base; pericarp membranous, 1 locule, 1 seed.

310

311



Figs. 310, 311. *Gonocarpus pithyoides*. 310. Distribution. 311. Flower (from *Helms s.n.*, NSW103122). Scale represents 1 mm.

DISTRIBUTION: *G. pithyoides* is confined to south-western Western Australia, most collections coming from within 50 km of Perth (Fig. 310).

ECOLOGY: Very little is recorded. The only available notes on habitat state "sand" (*A.M.B. UWA499*) and "sandy heath" (*Ostenfeld 641*). Flowering occurs from October to November and fruiting from (October-) November to December.

SPECIMENS EXAMINED:

WESTERN AUSTRALIA: Anon. s.n., Bibra Lake near Fremantle, UWA500 (fl.); *A.M.B. s.n.*, 3.xi.1943, Crawly, Kings Park Collection, UWA499 (fl.); *Drummond s.n.*, 1843, Swan River, P (fl.); *Drummond 706*, W.A., MEL39214 (fl.); *Fitzgerald s.n.*, -.xi.1902, Bayswater, NSW98951 p.p. (fl.); *Fitzgerald s.n.*, -.xi.1902, nr. Perth, NSW98952 (fl.); *Forrest s.n.*, 1878, near Perth, MEL39211 (fr.); *Gardner s.n.*, -.xi.1920, Spearwood, PERTH (fl.); *Gardner s.n.*, -.x.1945, Gnangarra, PERTH (fl.); *Havel 237*, 23.xii.1965, Banksia road, N.E. of Yanchep, PERTH (fr.); *Helms s.n.*, 11.x.1899, Gooseberry Hills, AD96921179, NSW103122 (fl., fr.); *Meebold 1757*, -.xi 1928, Beaufort, Perth, M (fl., fr.); *Morrison s.n.*, 11.xii.1897, Melville Park, BRI084820, CANB136635, PERTH (fl., fr.); *Morrison s.n.*, 4.xi.1898, Subiaco, BRI079989, PERTH (fl.) — pollen sent to Palyn. Lab. Stockholm sub nom. *Haloragis cordigera* or *H. pithyoides*; *Morrison s.n.*, 12.xi.1898, Cannington, BRI080088 (fl.); *Morrison s.n.*, 15.xi.1899, ar Perth, BRI087237, CANB136634 (fl., fr.); *Morrison s.n.*, 22.xi.1900, Bayswater, CANB136632, PERTH (fl., fr.); *Morrison s.n.*, 28.xi.1900, Cannington, PERTH (fr.); *Morrison 7056*, 11.xii.1897, Melville Park, MEL (fr.); *Morrison 9075*, 15.xi.1899, near Perth, NSW (fl.); *Mueller s.n.*, -.xi.1877, Swan River, MEL39212 (fl., fr.); *Mueller s.n.*, -.xi.1877, Arrowsmiths River, MEL39215 (fl.); *Ostenfeld 641*, 18.x.1914, Bayswater, NSW, PERTH (fl.); *H.P. s.n.*,-.xi.1939, Kings Pk., UWA497 (fl.); *Preiss 1224*, 28.xi. 1839, 1837-1840, 1843, prope urbiculam Perth, G (herb. Boiss. & DC.), LE, M, MEL, P, PR, W (4 sheets) (fl., fr.) — holo and isotypes of *G. pithyoides*; *G.G.S. s.n.*, Kings Park, UWA498 (fl., fr.).

Of the eight type sheets examined, that in LE is considered most likely to be the holotype for two reasons. Besides one sheet in W (333985 p.p.) it is the only one to bear the full type citation as in Nees' publication. Furthermore, the case of *Gonocarpus nodulosus* Nees, where the holotype is certainly the one in LE, rather than W, suggests that Nees' specimens (of Haloragaceae at least) are in LE.

A collection by Diels & Pritzel (*Diels & Pritzel 162/188*, -.xii.1900, Swan Distr.: Bayswater, PERTH (fr.)) appears to be a hybrid between *G. pithyoides* and *G. cordiger*. The body of the fruit is that of *G. cordiger*, but the sepals are those of *G. pithyoides*. The two species are probably closely related, and often grow together.

There is considerable variation in the distribution of the indumentum on the plants of this species. The collections *Morrison s.n.* (28.xi.1900, PERTH) and *Preiss 1224* (MEL39216) are completely glabrous. Most others have sparsely scabrous stems and leaves, and a tuft of hairs at the base of the ovary/fruit. In the collections *Preiss 1224* (all W sheets), *Morrison 7056*, and *Forrest s.n.* (MEL39211) the ribs of the fruit are also sparsely scabrous, and in *Mueller s.n.* (MEL39212) the fruit is very densely pilose.

The closest allies of this species are *G. cordiger* and *G. pusillus*. *G. pithyoides* differs from *G. cordiger* in having a shorter, turbinate (not obconical) ovary, and sepals without auricles. *G. pusillus* differs from both of these species in its opposite leaves and smaller stature.

31. **Gonocarpus simplex** (R. Br. ex Britt.) Orchard

Gonocarpus simplex (R. Br. ex Britten) Orchard, comb. nov.

Haloragis simplex R. Brown ex Britten, J. Bot. 45 (1907) 136-137 [Typus: "R. Brown 4438, Bay I. South Coast, Jan. 1802." Holotypus: n.v.]

Haloragis pusilla var. (?) *subaphylla* Benth., Fl. Aust. 2 (1864) 481 [Typus: "S. Coast, R. Brown." Holotypus: n.v.] Schindler, Pflrch 23 (1905) 39; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 467.

FIG.: Blackall & Grieve, W. Aust. Wildfls 3 (1965) 467.

Erect clump-forming herb 10 cm tall, rootstock fibrous; stems erect, green, ± unbranched, lacking ribs, glabrous.

Leaves very few, reddish, alternate, deciduous, linear or bract-like, 1.5-2.0 mm long, 0.2-0.3 mm wide, sessile, set in notches of the stem, acute, entire, ± channelled above, glabrous.

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Lateral inflorescences absent. Primary bracts indistinguishable from upper leaves, ± stem clasping at base. Secondary bracts red, membranous, linear, 1.3 mm long, 0.15 mm wide, acute, glabrous.

Flowers 4-merous, ± sessile. Sepals 4, silver-grey, linear-deltoid, 0.4 mm long, 0.2 mm wide, weakly midribbed, glabrous. Petals 4, red, hooded-navicular, keeled, 1.7 mm long, 0.3 mm wide (keel to margin), glabrous. Stamens 8, filaments 0.1-0.2 mm long; anthers yellow, oblong to narrowly ovate, 0.7-0.9 mm long, 0.2 mm wide, 4-locular, nonapiculate. Styles 4. Ovary silver-grey, linear to ovoid, 0.7-0.9 mm long, 0.3 mm wide, 4-ribbed opposite petals, glabrous.

Fruit unknown.

Distribution: *G. simplex* is confined to the vicinity of Albany in south-western Western Australia.

Ecology: Very little is recorded. Andrews' collection came from "swamp ground" and was flowering in mid-December.

Specimens examined:

WESTERN AUSTRALIA: Andrews s.n., 18.xii.1902, Albany, NSW98956 (fl.).

The collection cited above seems to be a duplicate of the "C. P. Andrews no. 287" cited by Britten (1907), and is the only collection of the species recorded, apart from the type. Fruits have apparently never been found.

Further collections are needed to determine whether the characteristic habit of this plant is constant. In its tightly clustered stems, naked but for a few bract-like leaves, it closely resembles a small Restionaceous plant, and could be easily overlooked.

Its relationships are obscure. Originally described as a variety of *Haloragis pusillus, Gonocarpus* ('*Haloragis*') *simplex* was removed from this position by Schindler, (reported in Britten, 1907) who suggested an affinity with *H. salsoloides*.

32. **Gonocarpus pycnostachyus** (F. v. M.) Orchard

Gonocarpus pycnostachyus (F. v. M.) Orchard, comb. nov.

Haloragis pycnostachya F. v. Mueller, Trans. R. Soc. Vict. 24 (1888) 135 [Typus: "Near Israelite Bay (Miss Brooke)". Holotypus: *S. Brooke s.n.,* 1885, Israelite Bay, MEL39221 (fl., fr.)!] F. v. M., Sec. Census 1 (1889) 85; Schindler, Pflrch 23 (1905) 28; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 465.

Figs.: Schindler, Pflrch 23 (1905) fig 6C; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 465.

Erect herb 15 cm tall, stems branched at base, red to green, unribbed, densely spreading pilose with simple, uniseriate, hyaline, 2-3-celled hairs 0.3-0.6 mm long.

Leaves decussate, on petioles 1-3 mm long; lamina ovate, 0.9-1.3 cm long, 0.6-0.8 cm wide, margin thickened, serrulate with 12-16 obliquely cuspidate teeth 0.5 mm long, midrib and lateral veins obscure, densely sub-appressed pilose on both faces with hairs as for stems.

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Lateral inflorescences arise in axils of upper leaves. Primary bracts green, fleshy, narrow-ovate to lanceolate, 3.0-5.5 mm long, 1.2-1.7 mm wide, ± sessile, entire, midribbed, pilose. Secondary bracts minute, brown, membranous, trifid, 0.6 mm long, 0.8 mm wide.

Flowers 4-merous, on pedicels 0.5-0.6 mm long. Sepals 4, olive-green, ovate, 0.8 mm long, 0.5 mm wide, entire, very small median basal callus, ciliate on margins with hairs 0.15 mm long, otherwise glabrous. Petals 4, deep red, hooded, keeled, shortly unguiculate, 2.1-2.2 mm long, 0.5-0.6 mm wide (keel to margin), pilose near keel. Stamens 8, filaments 0.1-0.2 mm long; anthers yellow to red, linear-oblong, 1.5-1.8 mm long, 0.3 mm wide, 4-celled, nonapiculate, antipetalous anthers 0.3 mm shorter than antisepalous ones. Styles 4, clavate, 0.3 mm long, stigmas capitate. Ovary silver-grey, obpyriform, 0.8 mm long, 0.7 mm wide, strongly verrucose in lower part, contracted into a narrow neck in upper half, neck 8-ribbed, the whole densely and minutely scabrous; septa incomplete, 4-locular with 1 ovule per locule.

Fruit on pedicel 0.5 mm long, obpyriform, 1.0-1.2 mm long, 0.8-0.9 mm wide, ± quadrangular, verrucose in lower half with 2 transverse rows of tubercles, contracted into an 8-ribbed neck in upper half, densely and minutely scabrous; sepals persistent, erect, ovate, 0.5 mm long, 0.5 mm wide, with styles reflexed between, margins ciliate; pericarp membranous, 1 seed.

Distribution: *G. pycnostachyus* is confined to the vicinity of Israelite Bay, south-western Western Australia.

Ecology: Nothing is known.

Specimens examined:

WESTERN AUSTRALIA: Brooke s.n., 1885, Israelite Bay, MEL39221 (fl., fr.) — type of *H. pycnostachya.*

The affinities of this species lie with *G. confertifolius* and *G. nodulosus.* With both species it shares its obpyriform to urceolate shaped fruit and long indumentum. From *G. confertifolius* it is distinguished by its larger leaves and shorter, broader calyx lobes, and from *G. nodulosus* by its leaf arrangement and size, and 8-stamened flowers.

33. **Gonocarpus confertifolius** (F. v. M.) Orchard (Fig. 312)

Gonocarpus confertifolius (F. v. M.) Orchard, comb. nov.

Haloragis confertifolia F. v. Mueller, Fragm. 10 (1876) 53 [Typus: "Prope fontes Victoria-Spring et Ularing; Young." Lectotypus (Orchard): *Young s.n.,* Q. Victoria Springs, MEL1003468 (fl.)!, excluding the specimen on the extreme right hand side of the sheet. Isolectotypus: *Herb. F. v. Mueller s.n.,* Victoria Springs, K (fl.)!; Syntypus: *Young s.n.,* 10-15 Oct. 1875, Near Ularing, MEL1003467 (fl.)!] F. v. M., Census 1 (1882) 49; F. v. M., Trans. R. Soc. Vict. 24 (1888) 135; F. v. M., Sec. Census 1 (1889) 85; Schindler, Bot Jb. 34, Beibl. 77 (1904) 30, 31, 35, 38, 40; Diels & Pritzel, Bot. Jb. 35 (1904) 447; Schindler, Pflrch 23 (1905) 26; Gardner, Enum. (1931) 99; Blackall & Grieve, W.A. Wildfls. 3 (1965) 465; Praglowski, Grana 10 (1970) 168.

Figs.: Schindler, Pflrch 23 (1905) fig. 6A; Blackall & Grieve, W.A. Wildfls. 3 (1965) 465; Praglowski, Grana 10 (1965) pl. 2 (d-i).

Annual or perennial herb, 7-30 cm tall, stems erect, ascending or decumbent, smooth or irregularly wrinkled, not longitudinally winged or ribbed, young stems densely spreading pilose with 1-3-celled simple transparent hairs 0.1-0.5 mm long, the older stems becoming ± glabrous.

Leaves decussate in lower parts of stem, spiral above or spirally arranged throughout, fleshy, sessile, rhomboidal to ovate to narrow-ovate, 2.5-8.0 mm long, 1.6-3.0 mm wide, entire or with 1-4 serrations near acute apex, margin ± thickened, especially towards apex, midrib and other venation obscure, both faces covered with appressed or spreading hairs as for stems.

Inflorescence an indeterminate spike of single flowers borne in axils of alternate primary bracts. Lateral inflorescences may arise in axils of upper leaves. Primary bracts leaflike, ovate to lanceolate, 2.0-3.5 mm long, 1.2-2.0 mm wide, entire, pilose on both surfaces. Secondary bracts brown, membranous, linear, 0.5-0.8 mm long, 0.1-0.3 mm wide, glabrous except for fringe of 1-celled hairs 0.4-0.5 mm long on margins, deciduous at or about anthesis.

Flowers solitary in axils of primary bracts, subtended by 2 secondary bracts. Sepals 4, narrow-lanceolate, 1.3-1.5 mm long, 0.4-0.5 mm wide, with basal median callus, glabrous except for fringe of transparent 3-celled hairs 0.7-1.0 mm long on margins. Petals 4, hooded, reddish brown with cream or greenish margin, 1.8-1.9 mm long, 0.5-0.6 mm wide (keel to margin), with 2-3 rows of 1-2-celled hairs 0.1-0.3 mm long on keel. Stamens 8, filaments 0.1-0.2 mm long; anthers reddish, oblong, 1.5-1.6 mm long, 0.4 mm wide, nonapiculate. Styles 4, 0.4 mm long, stigmas globose, golden fimbriate, the fimbriae ca 0.2 mm long. Ovary dull or shiny brown, ovoid, 1.0-1.2 mm long, 0.7-0.8 mm wide, contracted into a short neck towards the top, 8-ribbed longitudinally with 3-4 verrucose calluses between the ribs, glabrous or covered with short scabrous hairs ca 0.01 mm long, incompletely 4-locular, septa spongy, columella present, ovules 4, pendulous.

Fruit size, sculpturing and indumentum as for the ovary, sepals persistent, spreading, seed solitary.

Key to varieties of *G. confertifolius*

Leaves 5.0-8.0 mm long, 2.0-3.0 mm wide; fruit glabrous.	var. *confertifolius*
Leaves 2.5-3.8 mm long, 1.6-2.5 mm wide; fruit scabrous.	var. *helmsii*

var. **confertifolius**

Stems erect, 30 cm tall, smooth, or older ones very slightly wrinkled, brown, young stems densely spreading pilose becoming ± glabrous at base of plant. Leaves all widely spaced, spirally arranged, or subopposite in lower parts, rhomboidal to broad lanceolate, 5.0-8.0 mm long, 2.0-3.0 mm wide, entire or with 1-2 small serrations near apex, midrib slightly prominent below, indistinct above, densely spreading pilose on both surfaces. Primary bracts leaflike, lanceolate, 2.0-3.0 (-3.5) mm long, 1.2-1.5 mm wide, entire, densely spreading pilose on both surfaces. Secondary bracts brown, membranous, linear, 0.5-0.8 mm long, 0.1-0.3 mm wide, excluding the fringe of marginal hairs. Sepals fringed with hairs, petals with hairs on keel, ovary glabrous. Fruits glabrous, brown, ± shiny.

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Fig. 312. Distribution of *Gonocarpus confertifolius* (○ = var. *confertifolius*, ● = var. *helmsii*).

Distribution: Southern Western Australia, on the plains east of Kalgoorlie and near Kirwan Siding (Fig. 312).

Ecology: Very little known. Flowers October, fruits May.

Specimens examined:

WESTERN AUSTRALIA: George 11172, 13.xi.1971, Kirwan Siding, N. of Cadoux, PERTH (fl.); *Herb. F. v. Mueller s.n.,* Victoria Springs, K (fl.) — isolectotype of *H. confertifolius*; *Wilson, with 5786,* 14.v.1967, 70 km N. of Zanthus, PERTH (fr.); *Young s.n.,* 10-15.x.1875, Near Ularing, MEL1003467 (fl.) — syntype of *H. confertifolius*; *Young s.n.,* Q. Victoria Springs, MEL1003468 (fl.) p.p. — lectotype of *H. confertifolius.*

var. **helmsii** Orchard, var. nov.

Folia ovata ad angustovata, 2.5-3.8 mm longa, 1.6-2.5 mm lata, basi caulis aggregata decussata; in inflorescentia spiralia. Ovarium et fructus minute scaber.

Typus: *R. Helms s.n.,* 23.xi.1891, Nr. Southern Cross, Yilgarn W.A. Sand. (Elder Exploring Expedition). Holotypus: AD96810032 (fl., fr.)! Isotypi: K (fl., fr.)!, MEL1003470 (fl.)!, NSW98955, 9830 (fl., fr.)!

Stems decumbent or ascending, 7-27 cm tall, smooth or irregularly wrinkled, densely spreading pilose, at least in the upper part. Leaves crowded and decussate in the lower (sterile) parts, becoming spiral towards the inflorescence, ovate to narrow ovate, 2.5-3.8 mm long, 1.6-2.5 mm wide, entire or 2-4-toothed towards the apex, densely ± appressed pilose on both faces, midrib indistinguishable. Primary bracts leaflike, ± same shape and size as leaves, becoming smaller only in upper part of inflorescence, sparsely scabrous on both faces with a fringe of longer hairs on margin. Secondary bracts brown, membranous linear, glabrous except for a fringe of 1-celled transparent hairs 0.4-0.5 mm long. Sepals fringed with hairs, petals with hairs on keel, ovary dull brown, scabrous with hairs ca 0.01 mm long. Fruit scabrous, dull brown.

Distribution: This variety is found in southern Western Australia, west and south of Kalgoorlie, and in south-western South Australia, at Ooldea. The latter record may be the result of a recent introduction via the Indian-Pacific railway (Fig. 312).

Ecology: Collectors' notes (Helms, Gardner) suggest that var. *helmsii* favours red or yellow sandy soil. Flowering specimens have been collected from August to November, and fruiting specimens in October and November.

Specimens examined:

WESTERN AUSTRALIA: Elder Expedition s.n., 1891, without locality, MEL1003469 (st.); *Gardner s.n.,* 17.viii.1931, west of Sandstone, PERTH (fl.) — pollen sent to Palyn. Lab. Stockholm; *Gardner s.n.,* -.iv.1943, Burracoppin, PERTH (st.); *Gardner 13546,* 10.x.1961, near Mount Churchman, PERTH (fl., fr.); *Helms s.n.,* 23.xi.1891, Nr. Southern Cross, Yilgarn, AD96810032 (fl., fr.) — holotype of *G. confertifolius* var. *helmsii,* K (fl., fr.), NSW9830, 98955 (fl., fr.), MEL1003470 (fl.) — isotypes of *G. confertifolius* var. *helmsii*; *Merrall s.n.,* 1890, Southern Cross, MEL1003471 (st.); *Orchard 1260,* 30.ix.1968, ca 34 km north of Widgiemooltha, AD (fl.). *SOUTH AUSTRALIA: Earle 78,* 11.xi.1934, near Ooldea Station, BISH (fl., fr.).

The choice of a lectotype for the name of the species is necessary as Mueller cited two distinct collections by Young in the original description. The collection from [Queen] Victoria Springs is chosen as the lectotype as duplicates of this collection are held in two herbaria (K, MEL), whereas the Ularing collection exists in MEL only.

The two varieties recognised here are distinguished principally on habit, size and arrangement of the leaves, and the presence or absence of scabrous hairs on the ovary and fruit.

34. **Gonocarpus nodulosus** Nees (Figs. 313-317)

Gonocarpus nodulosus Nees, in Lehmann, Pl. Preiss. 1 (1844) 158 ['Goniocarpus'] [Typus: "In Australia occidentali. Herb. Preiss No. 2378". Holotypus: *Preiss 2378*, 1843, in Australia occidentale, LE (herb. Nees) (fr.)! Isotypi: *Preiss 2378*, 1843, in Col. Swan river, G (herb. DC.) (fl., fr.)!; *Preiss 2378*, Western Australia, MEL 39182 (fl., fr.); *Dr Preiss 2378*, 1843, in Australasia occidentali, (Swan River Colonia), MEL39186 (fl., fr.)!; *Anon. 2378*, W (herb. Lehmann) (fl., fr.)!]

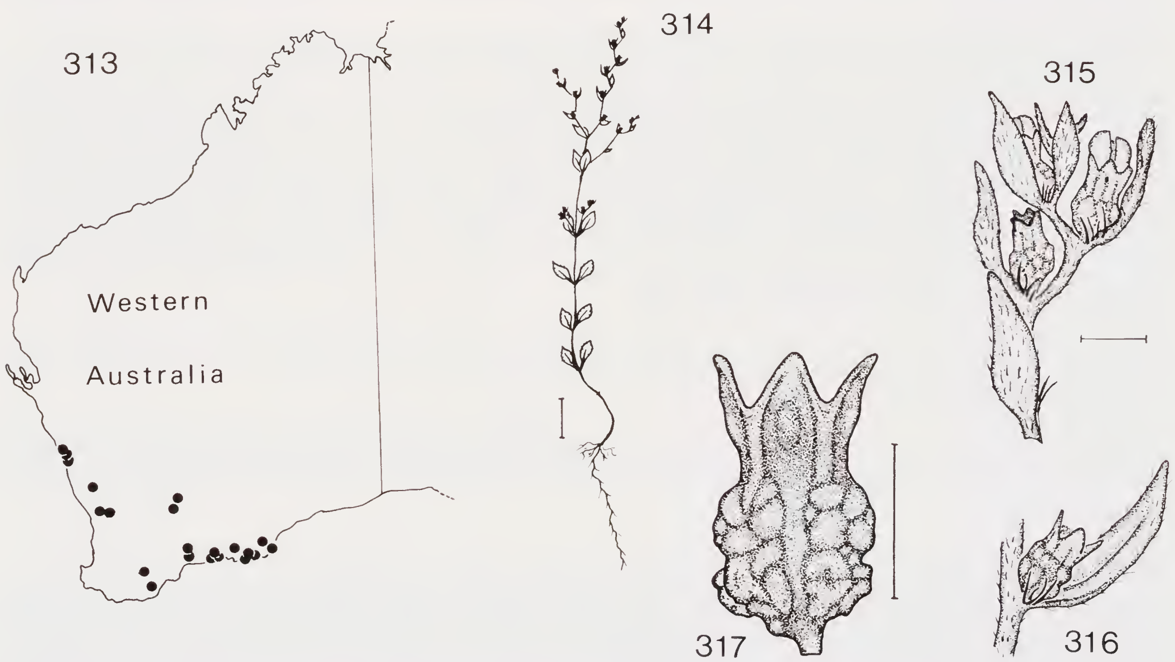
Haloragis nodulosa (Nees) Walpers, Rep. 5 (1846) 672; Benth., Fl. Aust. 2 (1864) 481; F. v. M., Census 1 (1882) 49; F. v. M., Trans. R. Soc. Vict. 24 (1888) 135; F. v. M., Sec. Census 1 (1889) 85; Diels & Pritzel, Bot. Jb. 35 (1904) 447; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 23, 30, 35; Schindler, Pflrch 23 (1905) 25; Gardner, Enum. (1931) 99; Parker, Fedde Rep. 29 (1931) 105; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 465; Praglowski, Grana 10 (1970) 168.

FIGS.: Schindler, Pflrch 23 (1905) fig. 5; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 465; Praglowski, Grana 10 (1970) pl. 2 (a-c).

Annual herb 5-15 (-30) cm tall (Fig. 314); rootstock a taproot; stems pale red to green, erect, weakly 4-ribbed, unbranched or oppositely branched near base, older stems glabrous, younger parts sparsely appressed pilose with white 1-2-celled simple hairs 0.2-0.3 mm long.

Leaves opposite, ± sessile, lanceolate to oblanceolate (to obovate), 3-6 (-15) mm long, 1.0-2.5 (-7.0) mm wide, apex acute or rounded, margin thickened, serrate with 6-8 (-12) minute teeth 0.1-0.3 mm long, midrib slightly prominent below, veins otherwise indistinct, glabrous, or very sparsely appressed pilose on upper surface only.

Inflorescence an indeterminate spike of flowers borne singly in axils of alternate primary bracts. Lateral inflorescences arise in axils of upper leaves. Primary bracts leaflike, sessile, lanceolate, 2.0-2.5 (-4.5) mm long, 0.6-0.8 (-1.3) mm wide, entire, appressed pilose on outer face. Secondary bracts (bracteoles) absent, replaced by ca 4 long hairs (Fig. 315).



Figs. 313-317. *Gonocarpus nodulosus*. 313. Distribution. 314. Habit. 315. Tip of inflorescence. 316. Fruit in axil of primary bract. 317. Fruit. (figs. 314, 317 from *Orchard 1080*, figs. 315, 316 from *Orchard 1542*). Scales represent 1 cm (fig. 314) or 1 mm (figs. 315-317).

Flowers 4-merous, ± sessile. Sepals 4, green, deltoid, 0.3-0.5 mm long, 0.2-0.3 mm wide, thick, smooth, glabrous. Petals 4, deep red, hooded, keeled, unguiculate,, 0.6-1.0 (-1.2) mm long, 0.1-0.2 mm wide (keel to margin), scarcely exceeding calyx, glabrous, or scabrous on keel. Stamens 4, antisepalous, filaments 0.1-0.2 mm long; anthers pale yellow, oblong, 0.4-0.6 mm long, 0.2 mm wide, 4-celled, non-apiculate. Styles 4, clavate, 0.1-0.2 mm long, stigmas red, fimbriate; receptacle beset with short erect hairs. Ovary purplish-brown urceolate, 0.7-1.0 mm long, 0.5 mm wide, basal half globular, irregularly verrucose, upper half cylindrical, prominently 8-ribbed, glabrous; septa incomplete, 4 locules, 1 ovule per locule.

Fruit silver-grey to reddish, urceolate, 1.0-1.3 mm long, 0.6-0.8 mm wide, irregularly verrucose in lower globular part, upper half contracted into 8-ribbed cylindrical neck; sepals green, persistent, ± spreading, deltoid, 0.2-0.3 mm long, 0.3 mm wide; glabrous, 1 seed (Figs. 316, 317).

Distribution: This species is confined to south-western Western Australia, where it is found from Cape Arid to Geraldton (Fig. 313).

Ecology: *G. nodulosus* is usually found in well drained sandy soils, often in the shade of other plants. Collectors' notes include "dry soil" (*Fitzgerald NSW99273*); "auf Moorboden" (*Meebold 617*); "sandy soil" (*Royce 9974*); "under shade of rock on granite rock" (*Saffrey 262*); and "growing in moss bed" (*Wilson 81782)*.Flowering occurs from August until November and fruiting from August until December.

Specimens examined:

WESTERN AUSTRALIA: Anon. s.n., -.x.1867, south of Stirling Range, MEL39179 (fl., fr.); *Anon. s.n.*, -.xi.1877, Greenough's & Irwin's River, MEL39191 (fl., fr.); *Brooke s.n.*, 1885, Israelite Bay, MEL39176 (fl., fr.); *Brooke s.n.*, 1889, near Mt. Rugged [= Ragged?], MEL39188 (fl., fr.); *Dempster s.n.*, 1876, between Esperance Bay and Frasers Range, MEL39175 (fl., fr.); *Diels 1815*, W. Australien, NSW (fr.); *Donner 2956*, 10.x.1968, ca 27 km north of Young River crossing on Ravensthorpe-Esperance main road, AD (fl., fr.); *Drummond s.n.*, W.A., MEL 39178, 39180, 39181 (fl.); *Drummond 707*, 1843, Swan River, P (fr.); *Drummond IV, 707*, Nov. Holl. austr.-occid., NSW87860 (st.); *Eaton s.n.*, 1889, interior of Western Australia, MEL39189 (fl., fr.); *Eichler 19998*, 26.ix.1968, in gully leading to Yerritup Creek, ca 13 km north of coast at Stokes Inlet, AD (fl., fr.); *Fitzgerald s.n.*, -.x.1901, Midland Junction, NSW98959 (fl., fr.); *Fitzgerald s.n.*, -.xi.1902, 3 m. [5 km] N. of Midland Junction, NSW99273 (fl., fr.); *Grover s.n.*, 1889, north of King Georges Sound, MEL1003745 (fl., fr.); *Helms s.n.*, 17.xi.1891, Karoling, MEL39183 (fl., fr.); *Helms s.n.*, -.xi.1891, west of Red Kangaroo Hill, MEL39187 (fl., fr.); *Koch 1276*, -.viii.1905, Watheroo, NSW (fl., fr.); *Koch 1676*, -.viii.1905, Watheroo Rabbit Fence, NSW (fr.); *Meebold 617*, -.x.1928, Swan View, M (fl., fr.); *Meebold 804*, -.xi.1928, Farm Etna, Broomhill, M (fl., fr.); *Merrall s.n.*, 1890, Parkers Range, MEL39184, 39185, 1003702 (fl., fr.); *Orchard 1301*, 2.x.1968, Howick Hill ca 100 km east of Esperance, AD (fl., fr.); *Orchard 1328*, 4.x.1968, Wittenoom Hills, ca 3 km west of Mt. Burdett, AD (fl., fr.); *Orchard 1542*, 14.x.1968, ca 18 km north-north-west of the coast at Stokes Inlet, AD (fl., fr.); *Preiss 2378*, 1843, Western Australia, G, LE, MEL (2 sheets), W (fl., fr.) — types of *H. nodulosa*; *Royce 9974*, 2.xii.1971, Thomas River, Cape Arid National Park, PERTH (fr.); *Saffrey 262*, 6.viii.1968, Mount Madden Water Reserve, SE of Lake King, PERTH (fl.); *Salasoo 29*, 14.ix.1949, on the Northam-Perth highway, 3-4 miles [5-6 km] from Northam, NSW (fl., fr.); *Sewell s.n.*, 1885, Upper Swan River, MEL39177, 1003740 (fr.); *Sewell s.n.*, 1889, sources of the Swan River, MEL1003699 (fl., fr.); *Sewell s.n.*, 1889, Champion Bay, MEL39190 (fl., fr.); *Wilson 5446*, 3.x.1966, 15 km W. of Ravensthorpe by Phillips River, PERTH (fl., fr.); *Wilson 81782*, 2.x.1968, High Island, Duke of Orleans Bay, PERTH (fl., fr.).

Schindler (1905) placed this species in its own subgenus (Pseudohalorrhagis) on the basis of its reduced number of stamens and papillose disc. The loss of one or other whorls of stamens is now known to be more widespread in *Gonocarpus* than previously suspected, but the papillose disc remains unique in the genus. In addition, the reduction of the secondary bracts (bracteoles) to 3-4 stiff hairs is also peculiar to *G. nodulosus*. However, in all other important respects (e.g. inflorescence and ovary structure) this plant agrees with other species of *Gonocarpus*, and there seems little point in segregating it from them. It is best regarded as a slightly aberrant species of *Gonocarpus*, probably with few close relatives, but coming nearest to *G. pycnostachyus* and *G. confertifolius*.

35. **Gonocarpus paniculatus** (R. Br. ex Benth.) Orchard (Fig. 318)

Gonocarpus paniculatus (R. Br. ex Benth.) Orchard, comb. nov.

Haloragis paniculata R. Brown ex Bentham, Fl. Aust. 2 (1864) 481 [Typus: "W. Australia. King George's Sound, R. Brown, Harvey", n.v.]; F. v. M., Census 1 (1882) 49; F. v. M., Trans. R. Soc. Vict. 24 (1888) 135; F. v. M., Sec. Census 1 (1889) 85; Schindler, Pflrch 23 (1905) 60 ['panniculata']; Britten, J. Bot. 45 (1907) 137; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 469; Praglowski, Grana 10 (1970) 182.

Fig.: Blackall & Grieve, W. Aust. Wildfls 3 (1965) 469.

Erect slender herb 40-65 cm tall, ± unbranched below the inflorescence, stems 4-angled or ± smooth, brown, ± glabrous (rarely a few widely scattered, white unicellular simple hairs ca 0.2 mm long on young branches).

Leaves decussate, sessile, narrow-linear, 2.0-5.0 cm long, 0.1-0.15 (-0.3) cm wide, obtuse, veins obscure, margin thickened, weakly crenulate, glabrous or sparsely scabrous with hairs as for stems.

Inflorescence a terminal spike of flowers borne singly (rarely 2 or 3) in the axils of alternate primary bracts. Lateral inflorescences arise in the axils of the upper leaves, these inflorescences themselves sometimes bearing laterals. Primary bracts linear, 1.5-3.0 mm long, 0.3-0.5 mm wide, entire, leaflike, glabrous or sparsely scabrous. Secondary bracts (bracteoles) ovate, 0.25-0.3 mm long, 0.25-0.3 mm wide, membranous.

Flowers 4-merous, on pedicels 0.4-0.5 mm long. Sepals 4, greenish, ovate, 0.5-0.7 mm long, 0.6 mm wide, smooth, glabrous. Petals 4, red to green, hooded, keeled, non-unguiculate, 1.3-2.0 mm long, 0.5-0.6 mm wide, scabrous on keel. Stamens 8, filaments 0.1-0.15 mm long; anthers yellow, oblong, 0.8-1.1 mm long, 0.2 mm wide, equisized, 4-celled, nonapiculate. Styles 4, clavate, 0.2-0.3 mm long, stigmas capitate. Ovary dark red-grey, oblong-ovoid, 0.7-1.0 mm long, 0.7 mm wide, sharply contracted at apex, strongly 8-ribbed, scabrous on ribs with short white hairs; incompletely 4-locular, 1 ovule per locule.

Mature fruit not seen. Immature fruit on pedicel 0.5 mm long, turbinate, 0.7-1.0 mm long, 0.7 mm wide, 8-ribbed, scabrous on ribs; sepals persistent, erect, enclosing styles; pericarp membranous, 1 seed.

Distribution: This species is confined to south-western Western Australia, from Albany to the vicinity of Perth (Fig. 318).

Fig. 318. Distribution of *Gonocarpus paniculatus*.

Ecology: Most collections have been made near rivers and lakes, and it appears that *G. paniculatus* prefers somewhat swampy habitats. The only collectors' notes available are "swamp — grey sand overlying clay (*Loneragan 255*) and "moist vallies on rivulets" (*Mueller MEL39208*). Flowering is recorded from November to January, and young fruits are also present in January.

Specimens examined:

WESTERN AUSTRALIA: Clarke s.n., S.W. Australia, MEL39213 (fl., fr.); *Cronin s.n.*, 1891, Lake Wagin, north of King Georges Sound, MEL1003697 (fl.); *Fitzgerald s.n.*, -.xii.1901, near Bayswater, NSW99116 (fl.); *Loneragan 255*, 3.xii.1962, Mersea Lake ca 12 miles [19 km] south Bridgetown, UWA (fl.); *Morrison s.n.*, 26.xi.1904, Beenup, Canning River, CANB136628 (fl.); *Morrison s.n.*, 25.i.1908, Bayswater, AD96344269, BRI080302, CANB136627 (fl., fr.); *Morrison 14118*, 26.xi.1904, Beenup, MEL (fl.); *Morrison 18016*, 25.i.1908, Bayswater, NSW (fl.); *Mueller s.n.*, -.xii.1877, Blackwood River, MEL39207 (fl.); *Mueller s.n.*, 7.xii.1877, Preston's and Collie's River, MEL39208 (fl.).

Schindler (1905) relying only on Bentham's description placed this species in subsection *Spongiocarpus* of *Haloragis*. This subsection is more or less equivalent to the genus *Haloragodendron* of the present treatment. Schindler later (Britten, 1907) removed the species to subsection *Trachyphyllum* (= *Haloragis* s. str.). However, the structure of the ovary, fruit and inflorescence leave no doubt that the true relationships of this species lie in *Gonocarpus*, with the species of the *G. rudis*, *G. intricatus*, *G. pithyoides* complex of south-western Western Australia. From all of these species *G. paniculatus* is sharply distinguished by its narrow-linear leaves and sparse indumentum.

Although the inflorescence of *G. paniculatus* conforms in most cases with the general pattern for *Gonocarpus* (i.e. with a single flower in the axil of each primary bract), in rare instances groups of 2 or 3 flowers can be found subtended by a single bract. This abnormal behaviour is also known to occur in *G. hexandrus.*

The Clarke collection (MEL39213) cited above was seen by Bentham, but he incorrectly included it under *Haloragis pithyoides* in Flora Australiensis (1864).

36. **Gonocarpus hexandrus** (F. v. M.) Orchard (Figs. 319-324)

Gonocarpus hexandrus (F. v. M.) Orchard, comb. nov.

Haloragis hexandra F. v. Mueller, Fragm. 3 (1862) 31 [Typus: "In locis uliginosis ad sinum Wilson's Inlet Novae Hollandiae austro-occidentalis. Oldfield". Holotypus: *Oldfield 758,* Wilson's Inlet, W. Aust. Bogs. Pt. diffuse, leaves fleshy. MEL1003573 (fl., fr.)! Isotypus: *Oldfield 758,* Wilson's Inlet. Bogs. Plt. tufted, branches diffuse, Lvs. fleshy. MEL1003569 (fls. — terat.)!]; Benth., Fl. Aust. 2 (1864) 478-9; F. v. M., Census 1 (1882) 49; F. v. M., Trans. R. Soc. Vict. 24 (1888) 134; F. v. M., Sec. Census 1 (1889) 85; Schindler, Bot. Jb. 34, Beibl. 77 (1904) 5; Schindler, Pflrch 23 (1905) 53-54; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 47; Praglowski, Grana 10 (1970) 180.

? *Haloragis lanceolata* R. Br. ex Benth., Fl. Aust. 2 (1864) 482 [Typus: "W. Australia. Marshes, King Georges Sound, R. Brown (Herb. R. Br.)" Holotypus: n.v.] F. v. M., Census 1 (1882) 49; F. v. M., Proc. Linn. Soc. N.S. Wales 10 (1885) 197; F. v. M., Sec. Census 1 (1889) 86; Gardner, Enum. (1931) 99; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 469.

Figs.: Schindler, Pflrch 23 (1905) fig. 16E; Blackall & Grieve, W. Aust. Wildfls. 3 (1965) 469, 471 (var. *integrifolia*).

Prostrate, ascending or erect perennial herbs or small shrubs 25-100 (-200) cm tall, much branched, the stems 4-ribbed, glabrous or sparsely pilose. Leaves opposite at base of plant becoming alternate in upper parts, (broad-) lanceolate to oblanceolate, ± sessile, entire or serrate, glabrous or pilose, size variable.

Inflorescence an indeterminate spike of (1-) 3-5 (-7) flowered dichasia, borne in the axils of alternately arranged primary bracts. Lateral inflorescences similar to the terminal one may be borne in the axils of the upper 6-12 leaves. Primary bracts green, leaflike, lanceolate, 2.5-8 mm long, 0.5-2.0 mm wide, sessile, usually ± entire, glabrous or pilose; secondary bracts brown, membranous, lanceolate, 0.3-0.7 mm long, 0.1 mm wide, ± entire; tertiary bracts minute.

Flowers trimerous, on pedicels 1-5 mm long, peduncles up to 1 mm long. Sepals 3, green, deltoid, 0.3-0.6 mm long, 0.4-0.7 mm wide, entire, lacking midribs, glabrous. Petals 3, green to cream, hooded, tip hooked, non-unguiculate, 1.7-2.5 mm long, 0.3-0.6 mm wide (keel to margin), glabrous or sparsely pilose along keel. Stamens 6, filaments 0.1-0.5 mm long; anthers cream to red, oblong, (1.0-) 1.5-1.7 (-2.1) mm long, 0.2-0.4 mm wide, 4-locular, nonapiculate, all equal. Styles 3, 0.1-0.5 mm long, stigmas fimbriate, cream or red. Ovary green, ovoid, (0.3-) 0.4-0.7 mm long, 0.5-0.7 mm wide, 3-ribbed opposite petals, 3 grooves opposite sepals, incompletely 3-locular, septa present only in lower part, with 1 ovule per locule, central columella present.

Fruit trigonous, 1.0-1.7 mm long, 0.6-1.0 mm wide, 3-ribbed opposite the petals, grooved opposite the sepals, ± irregularly rugose between, 1-locular at apex, ± 3-locular at base, septa membranous; sepals persistent, enclosing styles, deltoid, 0.6-0.7 mm long, 0.6-0.8 mm wide; 1 seed occupying entire fruit.

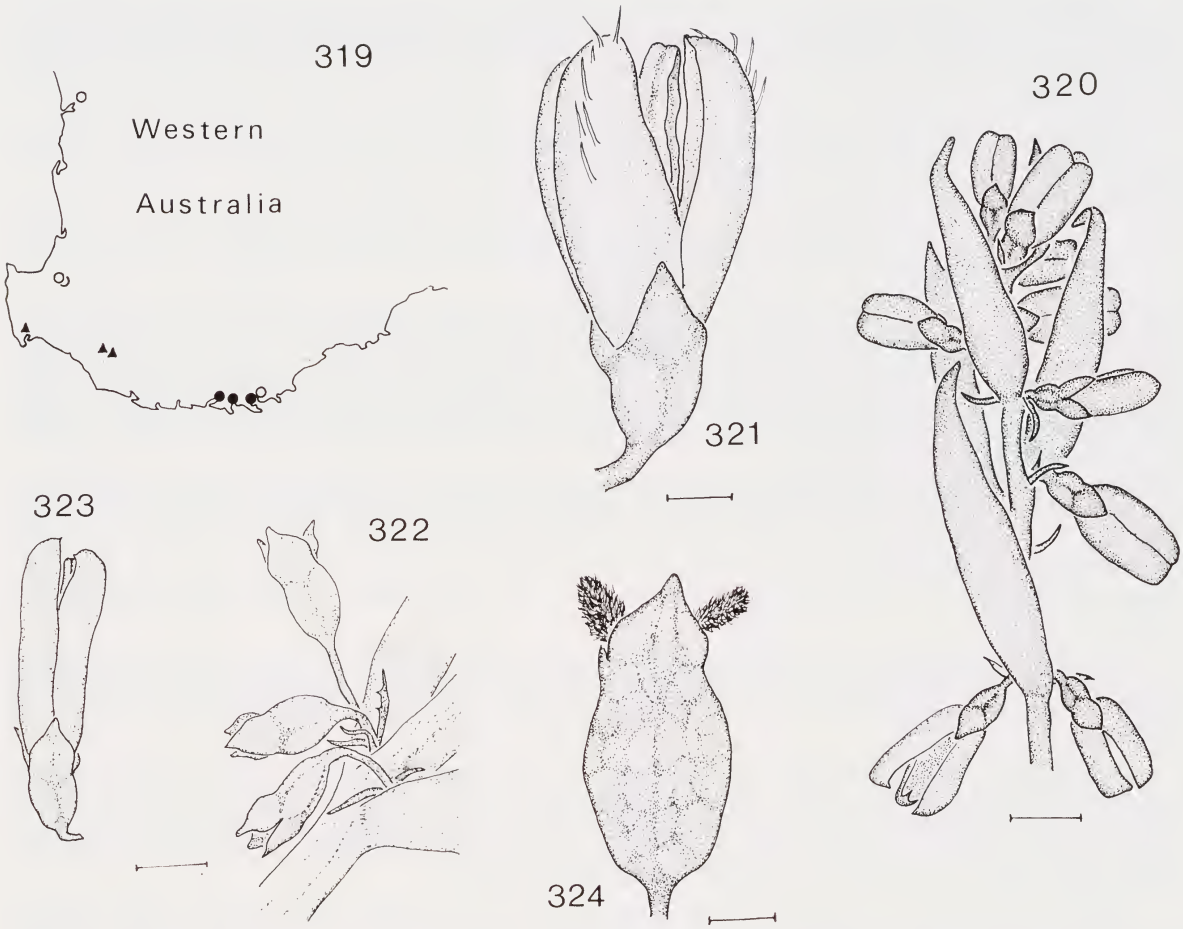
Key to subspecies of *G. hexandrus*

1. Leaves 1.5-2.0 cm long, (0.25-) 0.4-0.6 cm wide; plant erect, 15 cm tall. — subsp. *hexandrus*
1. Leaves 3.0-5.0 cm long, 0.7-1.7 cm wide; plant weak stemmed, twining, up to 2 m tall.
    2. Leaves strongly serrate towards apex, teeth 1-3 mm long. — subsp. *serratus*
    2. Leaves weakly serrate towards apex, teeth 0.5 mm long. — subsp. *integrifolius*

subsp. **hexandrus**

Perennial herb 8-15 cm tall; rootstock perennial, much branched; stems annual, numerous, arising ± unbranched from rootstock, ± 4-angled, green or reddish, glabrous. Leaves decussate in lower parts, becoming alternate higher up, lanceolate to oblanceolate, obovate or obcuneate, 1.5:2.0 cm long, (0.25-) 0.4 (-0.6) cm wide, entire, fleshy, apex acute, tapering gradually towards base, ± sessile, midrib indistinct, slightly prominent on lower surface, glabrous.

Inflorescence an unbranched indeterminate spike, with dichasia of 1-3 flowers in the axils of alternately arranged primary bracts. Primary bracts leaflike, green, fleshy, lanceolate, 2.5-8.0 mm long, 0.8-2.0 mm wide, entire, no veins apparent; secondary bracts membranous, deltoid to lanceolate, 0.3-0.5 (-0.8) mm long, 0.1 mm wide; tertiary bracts extremely minute or absent (Fig. 320).



Figs. 319-324. *Gonocarpus hexandrus*. 319. Distribution. (● = subsp. *hexandrus*, ▲ = subsp. *serratus*, ○ = subsp. *integrifolius*). 320. Tip of inflorescence of subsp. *hexandrus* (from *Fitzgerald s.n.*, AD96920052). 321. Flower of subsp. *serratus* (from *Koch 2259*). 322-324. subsp. *integrifolius*. 322. Portion of inflorescence. 323. Flower. 324. Fruit. (figs. 322, 323 from *Morrison s.n.*, CANB136629; fig. 324 from *Koch 2166*). Scales represent 1 mm (figs. 320-324).

Flowers 3-merous. Sepals 3, green, deltoid, 0.3-0.4 mm long, 0.5-0.6 mm wide lacking midrib. Petals 3, yellow-green, hooded, tip hooked, 1.8-2.2 mm long, 0.5-0.6 mm wide (keel to margin). Stamens 6, filaments 0.1 mm long; anthers yellow, oblong, 1.5-1.7 mm long, 0.3-0.4 mm wide, nonapiculate, all equal size, 4-locular. Styles 3, bent towards centre, 0.1-0.2 mm long, stigmas red, cylindrical. Ovary ovoid, 0.3-0.4 (-0.7) mm long, 0.4-0.5 (-0.7) mm wide, 3-ribbed opposite the petals, 3-furrowed opposite the sepals, incompletely 3-locular, septa present in lower half of ovary only; ovules 3, pendulous.

Fruit trigonous, 1.1 mm long, 1.0 mm wide, 3-ribbed opposite the petals, 3-furrowed opposite the sepals; sepals persistent, erect, deltoid, 0.6 mm long, 0.8 mm wide, enclosing the styles; ± 1-locular (membranous septa in base), seeds not seen.

Distribution: This subspecies is known only from the vicinity of Wilson's Inlet, about 30 km west of Albany in south-west Western Australia (Fig. 319).

Ecology: The plant is apparently confined to wet, boggy areas. Collectors' notes include "Bogs" (*Oldfield 758*) and "in wet vallies and on rivulets" (*Mueller MEL1003563, 1003574*). Flowers and fruits are present in December.

Specimens examined:

WESTERN AUSTRALIA: Fitzgerald s.n., -.xi.1907, Albany, AD96920052 (fl.); *Mueller s.n.*, Wilson's Inlet, MEL1003562 (fl., fr., some terat.); *Mueller s.n.*, 22.xii.1877, between K.G.S. [King Georges Sound] and Wilson's Inlet, MEL1003563, 1003574 (fl., fr.); *Oldfield s.n.*, Wilson's Inlet, MEL1003572 (fl.); *Oldfield 758*, Wilson's Inlet, MEL1003569 (fl., terat.), MEL1003573 (fl., fr.) — isotype and holotype of *H. hexandra*.

Haloragis lanceolata would seem (ex descr.) to belong here. It agrees with *G. hexandrus* subsp. *hexandrus* in all respects except its reported 4-merous calyx and 4-angled ovary, and was apparently collected very close to the known localities of this subspecies. I have not seen type material of *H. lanceolata,* and have therefore been unable to check on the points of disagreement. "*H. lanceolata*" is known only from the type collection, and *G. hexandrus* subsp. *hexandrus* has not been collected since 1907.

subsp. **serratus** (Schindler) Orchard, comb. et stat. nov.

Haloragis hexandra var. α *serrata* Schindler, Pflrch 23 (1905) 54 [Typus: "Nord-Australien: Port Walcott (Diels n. 7832). — Herb. Berlin" (destroyed). Lectotypus (Orchard): *P. Walcott s.n.,* Dec. 67, Hab. Valley in the Karri Country, Loc. Karri Dale, MEL1003564 (fl.)! Syntypi: *P. Walcott s.n.,* Jan. 1868, Height 12 to 36 inches, Hab. Springs & brooks, Loc. Warren River, MEL1003568 (fl.)!; *P. Walcott s.n.,* W.A., MEL1003571 (fl.)!]

Perennial herb, stems weakly ascending, ± twining, 25-35 cm long (up to 2 m — *Koch 2259*), ± 4-ribbed, sparsely pilose, the hairs soft, simple, 5-6-celled, transparent except for red-purplish pigment on transverse walls. Leaves opposite in lower part, alternate above, not fleshy, broad lanceolate-oblanceolate, 3.0-3.5 (-5.0) cm long, 0.7-1.2 (-1.7) cm wide, ± sessile, tapering gradually to base, apex acute, ca 6 teeth 1-3 mm long in upper half, midrib slightly channelled on upper surface, prominent below, lateral veins indistinct, diverging at an angle of 15°-20° to midrib, hairs as for the stems sparsely scattered along margins and on lower surface of midrib.

Inflorescence an indeterminate spike of (1-) 3-5-flowered dichasia borne in the axils of primary bracts; all flowers developing to anthesis. Lateral inflorescences are borne in the axils of several (6-12) of the upper leaves. Primary bracts green, leaflike, lanceolate, 3-8 mm long, 0.5-2.0 mm wide, ± entire (occasionally 1-2 serrations in upper part), sessile, apex acute, midrib distinct, pilose on margins with hairs as for stems. Secondary bracts brown, membranous, lanceolate,, 0.5-0.7 mm long, 0.1-0.2 mm wide, entire or 1-2 serrate. Tertiary bracts membranous, deltoid-lanceolate, 0.1-0.2 mm long.

Flowers 3-merous, on pedicels 1-3 mm long (Fig. 321), peduncles 1 mm long. Sepals 3, deltoid, 0.6 mm long, 0.5-0.7 mm wide, entire, lacking midrib, glabrous. Petals 3, hooded, non-unguiculate, apex hooked, 1.7-2.5 mm long, 0.6 mm wide (keel to margin), single row of hairs along keel, the hairs as for the stem, but sometimes only 2-3-celled, 0.05-0.20 mm long. Stamens 6, filaments 0.1 mm long; anthers yellow, oblong, 1.8-2.1 mm long, 0.2-0.3 mm wide, nonapiculate, 4-locular. Styles 3, bulbous based, 0.4-0.5 mm long, stigmas oblong. Ovary trigonous, 0.6-0.7 mm long, 0.5 mm wide, 3-ribbed opposite petals, 3-furrowed opposite sepals, 1 locule, central columella, 3 pendulous ovules.

Fruit not seen.

DISTRIBUTION: This subspecies is known only from the vicinity of Pemberton on the Warren River, about 270 km south of Perth in south-western Western Australia (Fig. 319).

ECOLOGY: The most favoured localities for this plant are apparently wet or boggy. Collectors' notes include "herbaceous perennial growing in moist places" *(Koch 2259)* and "springs and banks Warren River" (*Walcott MEL1003568*). Flowers present in December and January, fruiting period unknown.

SPECIMENS EXAMINED:

WESTERN AUSTRALIA: Koch 2259, -.xii.1916, Big Brook, MEL (fl.); *Koch 2259,* -.i.1917, Big Brook, Pemberton, NSW (2 sheets) (fl.); *Koch 2259,* Pemberton, MEL, NSW (2 sheets) (fl.); *Walcott s.n.,* W.A. [Western Australia], MEL1003571 (fl.) — syntype of *H. hexandra* var. *serrata*; *Walcott s.n.,* -.xii.1867, Karri Dale, MEL 1003564 (fl.) — lectotype of *H. hexandra* var. *serrata*; *Walcott s.n.,* -.i.1868, Warren River, MEL1003568 (fl.) — syntype of *H. hexandra* var. *serrata.*

The choice of a lectotype is necessary as the holotype in B cited by Schindler has been destroyed. No duplicate of *Diels n. 7832* which could serve as lectotype, can be located, but three collections in MEL, all matching Schindler's description, have the collector P. Walcott. All three are from Western Australia. As it appears likely that Schindler's locality Port Walcott was in fact the collector's name, P. Walcott, one of the MEL collections can be chosen as lectotype, the other two becoming syntypes. The specimen here designated lectotype is chosen because, of the two sheets with adequate labels, this one (MEL1003564) contains the better and more copious material.

subsp. **integrifolius** (Schindler) Orchard, comb. et stat. nov.

Haloragis hexandra var. β *integrifolia* Schindler, Pflrch 23 (1905) 54 [Typus: "West Australien: Swan River (Drummond IV. n. 84) — Herb. Boiss., Delessert, Petersb., Wien." Lectotypus (Orchard): *J. Drummond IV. 84,* Australia, ad fl. Cygnorum, LE (young fr.)! Syntypi (Isolectotypi): *Drummond 84,* 1848, Swan River, G (herb. Boiss., herb. Delessert) (fr.) , *J. Dr. 84,* W.A., MEL100 3565 (fl., fr.) , *Drummond 84,* Swan River, P (fr.)!]; Blackall & Grieve, W. Aust. Wildfls 3 (1965) 47.

Prostrate or weakly ascending densely branched perennial herb, up to 1.75 m tall, stems 4-ribbed, glabrous. Leaves opposite in lower parts, alternate above, not fleshy, lanceolate to oblanceolate, 3.0-5.0 cm long, 0.7-1.3 cm wide, widest at or just above the middle, tapering gradually towards the sessile base, more abruptly towards the apex, 3-5 minute teeth 0.5 mm long in upper part, midrib sunken above, prominent below, lateral veins obscure, diverging from the midrib at 20°-25°, glabrous.

Inflorescence an indeterminate spike of 3-7-flowered (1-3 functional) dichasia in the axils of alternate primary bracts. Lateral inflorescences arise in the axils of the upper leaves. Primary bracts green, leaf-like, lanceolate, 3-6 mm long, 0.5-1.0 mm wide, entire, no midrib; secondary bracts brown, membranous, lanceolate, 0.4-0.5 mm long, 0.1 mm wide, entire; tertiary bracts brown, membranous, 0.1 mm long (Fig. 322).

Flowers trimerous, on pedicels 0.5 mm long (Fig. 323), peduncles minute or ± absent. Sepals 3, green, deltoid, 0.5 mm long, 0.4-0.5 mm wide, entire, glabrous. Petals 3, cream, hooded, 2.2-2.5 mm long, 0.3-0.4 mm wide (keel to margin), glabrous. Stamens 6, filaments 0.5 mm long; anthers cream to red, linear-oblong, 1.0 mm long, 0.2 mm wide, nonapiculate. Styles 3, ± oblong, 0.5 mm long, stigmas fimbriate, cream. Ovary green, ovoid, 0.7 mm long, 0.6-0.7 mm wide, 3-ribbed opposite petals, 3-furrowed opposite sepals, glabrous, 1-celled except at base (3 membranous septa at base only), columella present, 3 pendulous ovules.

Fruit shaped as for ovary, 1.0-1.5 mm long, 0.6-1.0 mm wide, 3-ribbed opposite petals, 3-furrowed opposite sepals, irregularly rugose between; sepals persistent, erect, 0.7 mm long, 0.6 mm wide, with styles reflexed between them; 1 locule (± 3-loculed at extreme base), 1 seed (Fig. 324).

Distribution: This subspecies has been collected from tributaries of the Swan River just east of Perth, Western Australia, from near Bunbury, ca 160 km due south of Perth, and from King Georges Sound (Fig. 319).

Ecology: Like the other two subspecies, subsp. *integrifolius* appears to favour wet habitats. It has only been collected near major, permanent watercourses. Collectors' notes include "growing in a tangled mass near water" (*Koch 2140*) and "prostrate, herbaceous, a tangled mass of branches" (*Koch 2166*). Flowers and fruits are present from October until January.

Specimens examined:

WESTERN AUSTRALIA: Baudin s.n., port du R. Georges, P (fl.); *Drummond 84,* W.A., MEL1003565 (fl., fr.); *Drummond 84,* 1848, Swan River, G (herb. Delessert, Boiss.), P (fr.) — syntypes *H. hexandra* var. *integrifolia*; *Drummond IV. 84,* Australia, ad fl. Cygnorum, LE (fr.) — lectotype of *H. hexandra* var. *integrifolia*; *Koch 2140,* -.x.1909, Lowden, Preston River distr., MEL, NSW (2 sheets) (fl.); *Koch 2166,* -.xii.1912, Swan Mill, Lowden, NSW (4 sheets) (fr.); *Morrison s.n.,* 8.i.1898, Midland Junction, Helena River, CANB136629 (fl., fr.).

The choice of a lectotype is necessary as Schindler failed to designate as holotype any one of the four duplicates of Drummond's collection. The specimen in LE is here chosen as the lectotype as it is the only one in which the numeral "IV" (= 4th collection) appears on the label. However, there is little doubt that the specimens in G and MEL are duplicates of the lectotype.

SPECIES EX GENERIBUS PRAECEDENTIBUS EXCLUSAE

Haloragis capensis Nois. & Cels. ex Colla, Hort. Ripul. (1824) 63, n.v. — excluded by Schindler (1905), identity uncertain, but not Haloragaceae (ex descr.).

Haloragis cyathiflora Fenzl, Enum. Pl. Hueg. (1837) 44 [Typus: "Fremantle ad Swan River (Hügel)" n.v.] = Gyrostemonaceae ? c.f. F. v. M., Trans. R. Soc. Vict. 24 (1888) 137.

Haloragis disticha Jack, Mal. Misc. 2 (1822) 19 [Typus: "Kayo Kanchil. Malay". n.v.] = *Anisophyllea disticha* (Jack) Baillon (Rhizophoraceae) c.f. Ridley, Fl. Malay. Pen. 1 (1922) 701; Clark, Fl. Brit. Ind. 2 (1878) 442; Ding Hou, Fl. Males. 5 (1958) 479; v.d. Meijden & Caspers, Fl. Males. 7 (1971) 246.

Haloragis jerosioides Perrier de la Bathie, Not. Syst. 14 (1952) 305-306 [Typus: "Bords d'une doline (petit lac temporaire) sur calcaire jurrasique, a la fin de la saison seche (octobre), vers 300m. d'altitude, plateau d'Ankara (Boina), Perrier 1097." Holotypus: *Perrier 1097,* 8.x.1900, Plateau d'Ankara, lac dissichi, P (fr.)!] = *Vahlia digyna* (Retz.) O. Ktze (Saxifragaceae) c.f. Raynal, Adansonia ser. 2, 6 (1967) 542.

Haloragis lambertii Montr., Mem. Acad. Lyon 10 (1860) 199 [Typus: "Ile Art, Decembri ad littora" n.v.] = *Senebiera integrifolia* DC. (Brassicaceae) c.f. Guillaumin & Beauvisage, Sp. Montr. (1914) 16.

Haloragis oligantha Wight & Arn., Prod. (1834) 338 [Typus: "Neelgherries" n.v.] = *Myriophyllum oliganthum* (W. & A.) F. v. M. (Haloragaceae) c.f. v.d. Meijden, Blumea 17 (1969) 308.

Haloragis podantha Schindler, Bot. Jb. 34, Beibl. 77 (1904) 40 — *nom. nud.*

Haloragis tetrandra Schott, in Sprengel, Syst. Veg. ed. 17, (1827) 405 [Typus: none cited] = *Laurembergia tetrandra* (Schott) Kanitz (Haloragaceae) c.f. Raynal, Webbia 19 (1965) 693.

Loudonia excelsa Kunth, Enum. Pl. 3 (1841) 250 = *Trachycarpus martiana* H. Wendl. (Palmae) c.f. Beccari, Webbia 1 (1905) 41.

V. DISCUSSION OF RELATIONSHIPS

Family HALORAGACEAE

Until the nineteenth century the genera and species now included in this family were too little known for any comprehensive consideration of their relationships. During the early 1800s, L. Richard (1808, "Hygrobiae"), R. Brown (1814, "Halorageae") and Jussieu (1817, "Cercodianae") all recognised the affinities of the major Haloragacean genera and gave the group family ['Ordo'] status. In Robert Brown's discussion of Haloragaceae *Haloragis* was considered to possess the basic characters of the family, and all other genera were seen to "differ by the suppression of parts or separation of sexes". This view of the family agrees quite well with the system arrived at in the present study, once allowance has been made for genera unknown to Brown, and after the removal of *Callitriche* and *Hippuris* (included in the family by Brown, with some reservations).

A. P. de Candolle (1828) recognised the anomalous nature of the latter two genera and put them in separate Tribes from the true Haloragaceae. However, his criteria for distinguishing the genera *Cercodia, Haloragis* and *Gonocarpus* ('*Goniocarpus*') (differences in the ribbing of the fruit) broke down when further species were added to the total of ten known to him.

Bentham (1864) recognised 36 species of *Haloragis*, divided into three Series on account of the arrangement of the leaves and primary bracts. Characters of the leaves, presence or absence of an indumentum, and the number of flower parts were the main features used to distinguish the species, and the relationships proposed between the species as well as their delineation, agree well with the present treatment. However, Bentham failed to recognise the differences in the inflorescences, flowers and fruits which distinguish the species of true *Haloragis* from *Gonocarpus* and *Haloragodendron*, and intermingled species of all three genera. At the infra-family level, Bentham recognised two subdivisions, "True Halorageae" consisting of *Loudonia, Haloragis, Meionectes* and *Myriophyllum* (separated by overall shape of the inflorescence, petal and fruit characters) and "Anomalous genera" comprising *Gunnera, Ceratophyllum* and *Callitriche*. Bentham (in Bentham & Hooker, 1865), in considering the family as a whole, added the genera *Serpicula, Proserpinaca* and *Hippuris* to the ones in his 1864 treatment, but excluded *Ceratophyllum*. *Trapa* was referred to Onagraceae. The major distinguishing characteristics of the genera were the number of flower parts and the distribution of the sexes. Haloragaceae was placed in the vicinity of, but not close to, Onagraceae, differing in habit, the small often imperfect flowers, the coriaceous, hooded, valvate (?) petals, the often 1-ovulate ovary with pendulous ovules, the free styles, copious endosperm and shape of the embryo. This judgment, and the basis for it, have been generally accepted by most authors as defining the position and characterisation of Haloragaceae until very recently.

Schindler (1904), in a prelude to his monograph of Haloragaceae (1905) discussed the characters and relationships of the genera, and concluded that *Hippuris* should be removed from the family. In 1905, Schindler excluded the genera *Hippuris, Callitriche, Trapa* and *Ceratophyllum* from Haloragaceae and separated *Gunnera* from the rest of the family in a mono-generic subfamily. The other genera, with the exception of *Myriophyllum* which was placed in its own tribe, were considered to be fairly closely inter-related. He placed the family near Onagraceae but pointed out the similarities between Haloragaceae and Cornaceae in, for example, the abundant endosperm of the seeds.

Joergensen (1923) and Soueges (1952) provided embryological evidence strongly supporting the removal of *Callitriche* from Haloragaceae, and suggested a position near Verbenaceae-Lamiaceae for this genus. Erdtman (1966) excluded *Callitriche* from Haloragaceae, based on considerations of pollen morphology.

Erdtman (1966) also pointed out a marked dissimilarity between the pollen of *Hippuris* and Haloragaceae. When this evidence is combined with the unusual mode of fertilisation, unitegmic ovules and haustorial suspensor of *Hippuris* described by Juel (1910, 1911) and Soueges (1922), and differences in basic chromosome number, the exclusion of *Hippuris* from Haloragaceae seems fully justified. However, in modern phylogenetic schemes Haloragaceae and Hippuridaceae are still placed together in Haloragales/ Hippuridales (Cronquist, 1968; Takhtajan, 1969), or in sub-order Haloragidineae (Thorne, 1968). An even wider separation is justified, but finding another place for Hippuridaceae is difficult.

Trapa, considered by e.g. de Jussieu (1805), to be closely allied to some genera now placed in Haloragaceae, was referred to Onagraceae by most later authors. Raimann (1893) put *Trapa* in its own family, Hydrocaryaceae, which came between Onagraceae and Haloragaceae. This separation

had earlier been made by Dumortier (1829) ['Trapaceae']. A relationship between Trapaceae and Haloragaceae is not supported by pollen morphology (Erdtman, 1966), embryology (Ghosh, 1954; Ram, 1956) or chromosome number (Trela-Sawicka, 1965).

Gunnera has usually been included in Haloragaceae (Bentham, 1864; Schindler, 1905), although recently it has been placed in the monogeneric family Gunneraceae (dating from Meisner, 1841, but not generally accepted until about 1935). Wettstein (1935) recognised the family principally on morphological grounds, but was probably strongly influenced by the embryological work of Modilewski (1908) and Samuels (1912). This evidence, in conjunction with the embryological work of Virkki (1962) and Bala Bawa (1969), the palynological findings of Cranwell (1942), Erdtman (1943, 1966), Selling (1947), Cookson & Pike (1954) and Praglowski (1970) and the data available from the chromosome number determinations of, for example, Beuzenberg & Hair (1963) strongly opposes the commonly held view of a close relationship between Gunneraceae and Haloragaceae. Rodriguez (1971) suggested the transfer of *Gunnera* to the Umbellales on the basis of gross morphology, cytology, and phytochemistry.

Ceratophyllum, included in Haloragaceae by Bentham (1864), and placed close to that family by many earlier authors, has no real affinity there, as shown by many differences in flower and fruit structure, embryology (Davis, 1966) and pollen morphology (Erdtman, 1966).

When the genera *Ceratophyllum, Hippuris, Callitriche, Gunnera* and *Trapa* are removed, Haloragaceae consists of eight genera: *Haloragis, Gonocarpus, Haloragodendron, Glischrocaryon, Meziella, Proserpinaca, Laurembergia* and *Myriophyllum*. In discussing the relationships of these genera and of the family as a whole, Robert Brown's choice of *Haloragis* as the "type" (i.e. typical or most generalised) genus, from which all other genera can be derived by reduction, may usefully be followed. Some of the more constant and distinctive morphological features of this archetype include its semi-shrub type of habit (perennial, ± woody), simple exstipulate leaves, 4-merous flowers with one whorl of sepals, petals and carpels, but 2 whorls of stamens; inferior, 4-locular ovary with 2 pendulous, anatropous ovules in each locule (one ovule per locule aborts at an early stage); 4 free styles, capitate stigmas, and an indehiscent, nut-like fruit.

This combination of characters has led most authors, from de Jussieu onwards, to place *Haloragis* and its allies either in or near to Onagraceae, and linked through this family to Lythraceae. Schindler (1905) suggested, in addition, an affinity with Cornaceae. Other workers, notably Hallier (1912), and Bentham (1864), suggested a relationship of at least some of the genera with *Ceratophyllum*. Shaw (perhaps influenced by Reichenbach, 1828) suggested an affinity with Datiscaceae, while Hallier (1912), Pulle (1952) and Cronquist (1968) saw links between Haloragaceae (particularly *Gunnera*) and Theligonaceae. Thorne placed Haloragaceae between Cornaceae and its allies and Araliaceae (including (Apiaceae). Other families worth considering in a discussion of relationships are those members of the Myrtalean alliance characterised by a 4-merous flower with a ± inferior, indehiscent ovary and few pendulous, anatropous ovules. These families include Combretaceae and Rhizophoraceae. The families Celastraceae and Aquifoliaceae (usually placed in Celastrales) also resemble Haloragaceae in some respects.

Ceratophyllum, Gunnera, Hippuris, Trapa and *Callitriche*, as discussed above, have no real affinity with Haloragaceae. Similarly, Theligonaceae and Datiscaceae differ from Haloragaceae in a large number of characteristics, particularly in embryology (Davis, 1966; Kapil & Rao, 1966), floral morphology (Davidson, 1973), and pollen morphology (Erdtman 1966), and are therefore most unlikely to be closely related to the latter family.

Aquifoliaceae, although not usually considered to be closely related to Haloragaceae (they are placed in different orders) have some features in common with that family. Of all of the families under consideration Aquifoliaceae most closely resemble Haloragaceae in details of embryology and have a primitive type of wood ray structure that could be ancestral to that in Haloragaceae. Unfortunately, no suitable comparative data are available on the floral vasculature of Aquifoliaceae. Factors tending to reduce the probability of a relationship between these families are the disagreement in basic chromosome numbers and in pollen morphology. In addition, the presence of stipules in Aquifoliaceae, and the unisexual flowers (and dioecious plants) found in many species, make a close relationship between this family and Haloragaceae unlikely.

Celastraceae, usually considered closely related to Aquifoliaceae, also closely resemble Haloragaceae in features of embryology. However, Celastraceae have a relatively advanced type of wood ray structure

in comparison with *Haloragis*, and only a weak resemblance to Haloragaceae in pollen morphology and basic chromosome number. The flowers of Celastraceae are sometimes unisexual and usually have a disc associated with the ovary. Because of these differences, Celastraceae, like Aquifoliaceae, can be dismissed from further consideration as close relatives of Haloragaceae: their few points of resemblance to Haloragaceae are probably the result of convergence.

Rhizophoraceae and Combretaceae, although appearing in the same Order as Haloragaceae in many phylogenetic schemes, are not usually considered to be closely related to that family. LeMaout & Decaisne (1873) dismissed the popular idea of a relationship between Haloragaceae and Onagraceae and suggested instead a relationship between the former family and Combretaceae. This suggestion has been disregarded (or overlooked) by subsequent authors. In embryological details, Rhizophoraceae and Combretaceae show quite good agreement with Haloragaceae, and in pollen morphology there is a slight resemblance between the grains of Haloragaceae and the other two families. Rhizophoraceae, but not Combretaceae, have a wood ray structure compatible with a common ancestry with *Haloragis*. Combretaceae also differ from Haloragaceae in possessing inter- and intra-xylary phloem. Other points of dissimilarity with the latter family are in the basic chromosome numbers, the stipules of Rhizophoraceae, the marked specialisation in Rhizophoraceae concomitant with its littoral habitat preference, and the tendency towards 5-merous flowers in Combretaceae. In aspects of their floral vasculature, Combretaceae and Rhizophoraceae show some similarity to Haloragaceae in that the girdle formed by their placental supply may be homologous with the placental vascular network of the latter family.

When all of the above characters, plus general morphology, are taken into account, the relationship between Haloragaceae and Rhizophoraceae-Combretaceae is seen to be fairly close, probably compatible with their inclusion in the same Order (as, for example, Rendle, 1925; Wettstein, 1935; Thorne, 1968) or in closely related Orders (Cronquist, 1968; Takhtajan, 1969). However, the similarities are not strong enough to postulate the derivation of Haloragaceae from Rhizophoraceae-Combretaceae (or vice versa).

Onagraceae, until very recently, have been considered to be the family most closely related to Haloragaceae (see, for example, Schindler, 1905; Rendle, 1925; Wettstein, 1935; Pulle, 1952). However, the studies of Bala Bawa (1969a) on the embryology of Haloragaceae revealed a number of major discrepancies (in e.g. embryo-sac development and embryogeny) between Haloragaceae and Onagraceae. Erdtman (1966) and Praglowski (1970) found only a slight resemblance between the pollen of Haloragaceae and some Onagraceae: Haloragaceae pollen apparently most closely resembles that of some members of the old "Amentiferae". Although the structure of the wood rays of Onagraceae is compatible with a relationship to Haloragaceae, the interxylary phloem found in the former family is not present in the latter. Another major difference between the two families is in the derivation of their placental and ovular traces. In Onagraceae the traces to the ovules traverse the septa from the peripheral bundles, but in Haloragaceae there is a central placental supply and the ovular traces come from a placental network at the apex of the ovary. However, Onagraceae share with Haloragaceae the annulus formed by fusion of the sepal and petal traces in their flowers, and also agree in basic chromosome number, in their tetramerous flowers and in their exstipulate leaves. Despite these similarities, it seems that the weight of evidence is against a close relationship between Haloragaceae and Onagraceae, since the agreement between these families in such aspects as embryology, pollen morphology, wood anatomy and floral vasculature is only as great, or less, than the agreement between Haloragaceae and Rhizophoraceae-Combretaceae.

Lythraceae, usually considered to be closely related to Onagraceae, and hence to Haloragaceae, show very good agreement to the former in aspects of embryology, pollen morphology, basic chromosome number, wood anatomy and floral vasculature. Lythraceae consequently show little agreement with Haloragaceae in these respects and must be dismissed as possible close relatives of that family.

Thorne (1968) placed Haloragaceae in fairly close proximity to Araliaceae. However, apart from a resemblance to Haloragaceae in general floral morphology, Araliaceae differ in their usually compound leaves with sheathing bases and stipular appendages, aspects of embryology and wood anatomy, in their basic chromosome number and in the glandular disc of the generally pentamerous flowers. On the other hand, Erdtman (1966) indicated some similarities in the pollen morphology of Araliaceae and Haloragaceae, and the placental network demonstrated in some Araliaceae by Philipson (1967) very closely resembles that in Haloragaceae, although the outer annulus formed from the petal and sepal traces is absent in Araliaceae. Overall, the resemblance of Araliaceae to Haloragaceae is slightly less than that of Rhizophoraceae to the latter family, but probably justifies the inclusion of all three in the one Order. Araliaceae cannot, on the evidence outlined above, be considered closely related to Haloragaceae.

Apiaceae closely resemble Araliaceae in details of embryology, pollen morphology, wood anatomy and floral vascular anatomy, consequently bearing a similar relationship to Haloragaceae as the latter family. Thorne's inclusion of Apiaceae in Araliaceae seems justified on this evidence. However the close relationship of Araliaceae *s.l.* to Haloragaceae is not supported.

The final family to be considered here is Cornaceae. Schindler (1905) mentioned that this family was possibly related to Haloragaceae, and Thorne (1968) placed the two families in adjacent suborders. Three groups within Cornaceae are worth considering separately: subfamily Cornoideae (esp. *Cornus*), the genus *Griselinia*, and the genus *Corokia*.

Cornoideae, although poorly known in this respect, resemble Haloragaceae fairly well in details of embryology, and the pollen of the two groups is comparable. The wood ray structure of Cornaceae is relatively primitive and could be ancestral to that found in Haloragaceae. Floral vasculature was studied in *Cornus* by Wilkinson (1944) and she was the first to note the constancy of the splitting and reuniting of the placental bundles in this genus. Eyde (1967) and Philipson (1967) both discussed this unusual pattern and came to different conclusions as to its significance. Neither author compared the pattern in Cornaceae with that in Haloragaceae (then unknown), yet there is a close similarity. Eyde suggested that the placental bundles in *Cornus* had been displaced from a formerly axial position. If they are (mentally) placed in an axial position and the placental ring rearranged accordingly, then the placentation pattern in *Cornus* comes very close to that in Haloragaceae. The outer annulus present in Haloragaceae is absent in Cornaceae.

The resemblance between *Corokia* and Haloragaceae is even stronger, as far as derivation of the placental supply is concerned. *Corokia* has an axial strand as well as the lateral bundles, but branches from the peripheral strands (antisepalous and antipetalous bundles) also contribute to the ovular supply. Eyde (1966) interpreted the placentation of *Corokia* as indicating an affinity with *Argophyllum* (Saxifragaceae) while Philipson (1967) thought that an affinity with Escalloniaceae was indicated (in Thorne's classification this amounts to the same thing). It seems equally reasonable to suggest a link between Haloragaceae and *Corokia* in the light of the above evidence.

Griselinia, an anomalous genus often included in Cornaceae, was given an isolated position between Escalloniaceae and Araliaceae-Cornaceae by Philipson (1967). When compared with Haloragaceae, the floral vasculature of *Griselinia* does not support a close relationship with that family.

Little is recorded of wood anatomy of either *Corokia* or *Griselinia*, and apparently neither has been investigated embryologically. Information in both of these fields would be useful to gauge their relationships more accurately. The basic chromosome numbers of *Corokia* and *Griselinia*, as determined by Hair and Beuzenberg (1959), do not support a close relationship between these genera and Haloragaceae.

In summary, the evidence from embryology, pollen morphology, wood anatomy, floral vasculature, basic chromosome number and gross morphology suggests that the family most closely related to Haloragaceae is Cornaceae, although the relationship of *Corokia*, recently removed from Cornaceae, (Philipson, 1967, Eyde, 1966) deserves closer attention. The two families Rhizophoraceae and Combretaceae also show a fairly close resemblance to Haloragaceae.

The view held by many authors, of a close relationship between Onagraceae and Haloragaceae via Trapaceae (often expressed as "a reduction series") is shown to be without foundation, as is the idea of a close relationship between Haloragaceae and the families Gunneraceae and Hippuridaceae.

Of the three recently proposed major phylogenetic schemes for the Angiosperms (Cronquist, 1968; Thorne, 1968, 1973; and Takhtajan, 1969) the above placement of the family is probably closest to that of Thorne, although the agreement is not complete. He includes the families Haloragaceae, Hippuridaceae and Gunneraceae in suborder Halorgineae, and recognises the relatively close affinities of Haloragaceae and Cornaceae.

Genus HALORAGIS (Fig. 325)

Only three previous attempts have been made to describe inter-specific relationships within this genus in a comprehensive manner. These were those of A. P. de Candolle (1828), Bentham (1864) and Schindler (1904, 1905).

De Candolle recognised six genera in his Tribe Cercodianae of Halorageae, viz. *Serpicula*, *Goniocarpus*, *Haloragis*, *Cercodia*, *Proserpinaca* and *Myriophyllum*. This tribe corresponds to the modern concept of the family Haloragaceae; the other tribes of de Candolle (Callitrichineae, Hippurideae and

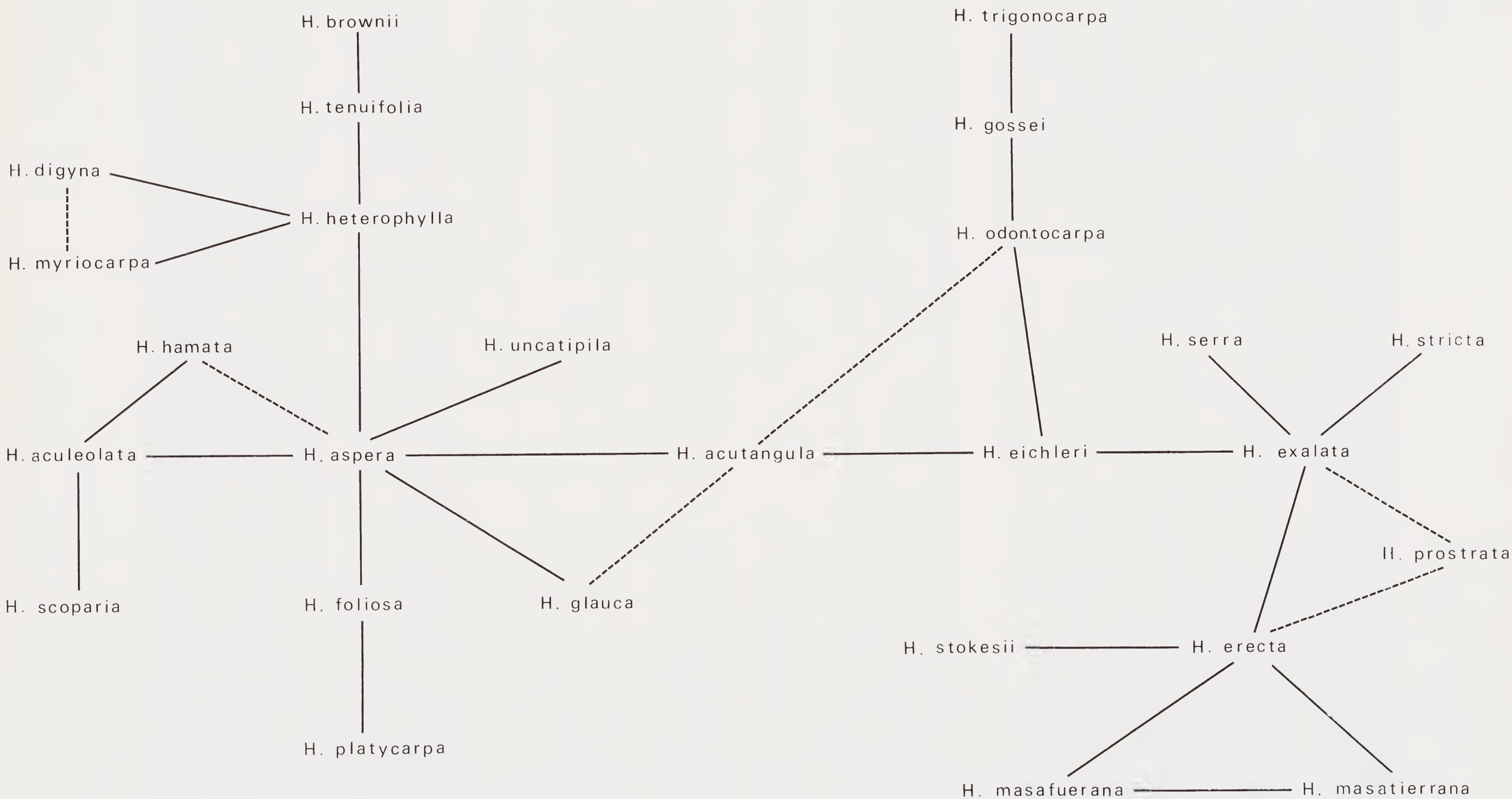


Fig. 325. Schematic representation of relationships in the genus *Haloragis*. Solid lines indicate strong affinity, dashed lines indicate uncertain affinity.

Gunnereae) (A. de Candolle (1868)), are now usually given individual family status. Of the genera mentioned above, only *Goniocarpus, Haloragis* and *Cercodia* are relevant to this discussion. They were distinguished from each other by the type of ribbing on the fruit: *Goniocarpus* had fruits which were 8-angled or 8-ribbed, *Haloragis* had smooth fruits and *Cercodia* had 4-angled, 4-winged fruits. *Goniocarpus* comprised *G. micranthus, G. scaber, G. microcarpus, G. tetragynus, G. tenellus* and *G. teucrioides.* These species are all included in *Gonocarpus* in the present study, and are discussed further under that genus. *Haloragis* contained only *H. prostrata* and *H. digyna* while *Cercodia* comprised *C. erecta* and *C. racemosa.* The present system cuts across that of de Candolle in that *C. racemosa* is made the type species of the new genus *Haloragodendron*, and *C. erecta* and *H. prostrata*, both species of *Haloragis*, are considered to be more closely allied to each other than either is to *H. digyna.*

In the definition of generic boundaries, A. P. de Candolle preferred to keep *Goniocarpus, Haloragis* and *Cercodia* separate, seeing *Cercodia* as intermediate between *Haloragis* and *Proserpinaca.* At the same time he recognised the possibility of combining them in a single genus, ("Goniocarpus et Cercodia forsan ut sectiones Haloragis habende"), as Robert Brown had done in 1814.

Bentham (1864) followed R. Brown in reducing *Gonocarpus* and *Cercodia* to synonymy under *Haloragis.* The genus was divided into three series: Series 1. Alternifoliae, with leaves ± alternate, Series 2. Oppositifoliae, with leaves opposite and primary bracts alternate, and Series 3. Oppositiflorae with both leaves and primary bracts opposite. Series Oppositiflorae contained only three species, all of which are now referred to *Gonocarpus.* The other two series contained a mixture of species now considered to represent both *Haloragis* and *Gonocarpus.*

When the *Gonocarpus* species are removed from Bentham's scheme, the arrangement is very close to the one postulated below, with one or two exceptions. *H. racemosa* should be transferred from Bentham's Series Oppositifoliae to the new genus *Haloragodendron*, and *H. glauca* and *H. heterophylla* are considered to be out of place in Series Oppositifoliae, having greater affinity with the basically alternate leaved species. (The leaves of *H. glauca* are usually alternate, sometimes subopposite at the base, while those of *H. heterophylla* are usually alternate or subopposite, rarely opposite.)

Schindler's arrangement of the species of *Haloragis* differed considerably from that of Bentham. Again *Gonocarpus* was included in *Haloragis*, but the two were (with a few exceptions) kept distinct in the Sections Monanthus (= *Gonocarpus*) and Pleianthus (= *Haloragis*). The exceptions are *H. pinnatifida, H. viridis, H. hexandra, H. paniculata* and *H. lanceolata*, which were all included in Section Pleianthus by Schindler, but are here considered to be better placed in *Gonocarpus. H. monosperma* and *H. racemosa* (incl. *H. baeuerlenii*), included in Section Pleianthus (as part of subsection Spongiocarpus) by Schindler are now placed in the new genus *Haloragodendron*, allied to *Glischrocaryon.* Schindler (1904, p. 35) pointed out the similarity of the winged fruits of *H. gossei, H. trigonocarpa, H. stricta* (?), *H. racemosa, H. odontocarpa* and *Glischrocaryon* ('*Loudonia*') but kept the genera distinct and the species of *Haloragis* in different subsections.

In the present treatment the species *H. racemosa, H. baeuerlenii, H. monosperma, H. lucasii* and the newly described *H. glandulosum* are segregated from *Haloragis* in the new genus *Haloragodendron* on the basis of differences in habit, ovary, anther, pollen, inflorescence and fruit characteristics (for details see under *Haloragodendron*). The remaining species in *Haloragis* (sensu Schindler) are divided almost equally between *Gonocarpus* and *Haloragis*, separated largely on characters of the fruit, ovary and inflorescence. *Gonocarpus* is characterised by an ovary with a central placental column and no septa except at the extreme base and apex, where it is divided into 2-4 locules by insubstantial septal partitions of hyphae-like cells. There is no increase in ovary size during fruit formation and maturation, and only a single seed matures from the 4-8 ovules. The fruit pericarp is usually membranous in texture, never woody or spongy. In the inflorescence, the flowers occur singly in the axils of the primary bracts (except in *G. hexandrus*).

Haloragis s. str. differs from *Gonocarpus* in having well developed septa which support the central placental strand. The septa run the entire length of the ovary, and become ± woody in the fruit. The ovary increases at least 2-3 times in size during fruit development and maturation, the septa and pericarp become ± woody, and the outer layers of the pericarp (exocarp) may become spongy or form wings, protuberances, etc. One to four seeds per fruit may develop, but irrespective of the number of mature seeds, each locule develops fully, even if empty (except in *H. eichleri*). In the inflorescence, the flowers occur in dichasia of (1-) 2-15 in the axils of the primary bracts.

Within the genus *Haloragis* (*s. str.*) the species fall into two main groups, centred about *H. aspera* and *H. exalata*. The groups are not given formal names and descriptions because of a number of intermediate species (e.g. *H. acutangula*) and some which are difficult to place (e.g. *H. platycarpa*). The species of the first group (centred about *H. aspera*) all normally have alternate leaves (rarely opposite or subopposite in some species) while the leaves of those in the second group (centred about *H. exalata*) are all opposite with the exception of *H. odontocarpa, H. gossei* and *H. trigonocarpa.*

H. aspera appears to be at the centre of a complex consisting of over half of the species of *Haloragis,* and has a number of closely related satellite species as well as being the starting point for four major lines of development. The species is widespread in the drier regions of eastern and south-central Australia, and is characterised by its hook-tipped scabrous hairs, green-glaucous leaves and stoloniferous rootstock. On the margins of its geographical range, *H. aspera* gives way to three closely related species, *H. uncatipila* in the north-west, *H. glauca* in the north-east and *H. heterophylla* in the east and south. Specimens suggesting introgression between *H. aspera* and each of these three species are known (see under each species for details) but no introgression between the three marginal species has been observed. *H. uncatipila* shares with *H. aspera* the hook-tipped hairs and green-glaucous serrate leaves, but differs in its spongy exocarp and lack of a stoloniferous rootstock. It is also the most robust plant of the four, forming rounded bushes up to 80 cm tall, while the others exist as semiprostrate or ascending straggling single stems from a stoloniferous rootstock. *H. glauca* has the same rootstock and basic fruit type (texture, ± shape) as *H. aspera*, but has grey-glaucous, ± entire leaves and is either glabrous or sparsely scabrous with straight or curved, not hooked, hairs. *H. heterophylla* also has a stoloniferous rootstock and hook-tipped hairs, but is a much more slender plant than any of the three previous species, with trifid leaves and much smaller fruits than *H. aspera*.

In Western Australia, *H. aspera* is parallelled in habit and general morphology by the three poorly known species *H. aculeolata, H. scoparia* and *H. foliosa.* Of these *H. foliosa* is probably most closely related to *H. aspera,* differing mainly in its ovate-cordate rather than deltoid sepals, and in its relatively longer, narrower leaves. *H. aculeolata* can also be readily derived from *H. aspera,* which it resembles in hair type and general leaf shape, by loss of the stoloniferous rootstock and a reduction in the gynoecium from 4 carpels to an unstable number of 2-3 carpels. From *H. aculeolata* can be derived *H. scoparia* which is glabrous and has a stable 2-partite gynoecium. *H. platycarpa* probably is allied to these three species but its exact affinities are difficult to determine. In general habit and leaf morphology, and in possessing a 4-partite gynoecium, *H. platycarpa* most closely resembles *H. foliosa*, but differs in being glabrous or papillose-hairy and in its peculiar depressed-globose, spongy fruit. More material of these four Western Australian species is badly needed to assess their variability and to determine more accurately their inter-relationships.

From *H. heterophylla* two lines of development lead respectively to *H. myriocarpa-H. digyna* and to *H. tenuifolia-H. brownii. H. myriocarpa* resembles *H. heterophylla* in its slender habit and small, 4-locular fruits. It differs however in having terete undivided leaves instead of trifid leaves; probably lacks a stoloniferous rootstock, and is glabrous or when sparsely scabrous on the leaves, has curved hairs, not hooked as in *H. heterophylla. H. myriocarpa* is found at and beyond the western limit of the range of *H. heterophylla* and occasional intermediate specimens collected in their region of overlap suggest possible introgression. *H. heterophylla* is usually found on heavy clay soils, often in low lying areas subject to flooding after heavy rain, while *H. myriocarpa* is found on emergent tussocks in fresh-water swamps. *H. digyna* is a more westerly species than *H. heterophylla* and *H. myriocarpa* but has some affinity with both. With *H. heterophylla* it shares its stoloniferous rootstock and general habit, while resembling *H. myriocarpa* in its hair type and linear (but shorter and flattened, ± toothed) leaves. It differs from both species in its reduction to a (1-) 2-3-merous floral plan. In this *H. digyna* approaches *H. hamata,* but the two species are distinguished on characters of the fruit, hairs and habit. *H. digyna* is a small, ± herbaceous plant with sparse, curved hairs and a relatively small fruit. *H. hamata* has larger fruits, hooked, relatively dense hairs and a more woody habit. In these respects *H. hamata* also approaches *H. aculeolata.*

The other line of development from *H. heterophylla* also shows a trend towards an aquatic habitat and reduction in number of floral parts. *H. tenuifolia* and *H. brownii* share with *H. heterophylla* its deeply dissected alternate leaves and perhaps a creeping rootstock, but are glabrous and have trimerous (*H. tenuifolia*) or bimerous (*H. brownii*) flowers and fruits. *H. tenuifolia* is found in swampy areas of Western Australia, *H. brownii* is a ± obligate emergent aquatic of south-western and south-eastern Australia.

H. acutangula, although almost certainly allied to this *H. aspera*-centred complex, is difficult to place more exactly. In leaf and fruit morphology it most closely resembles *H. aspera*, and furthermore occurs on the south-western margin of that species's range, but in a completely different habitat. *H. aspera* is found on heavy clay soils in inland localities, often associated with creeks and rivers, while *H. acutangula* grows in deep sand or in shallow sandy soils over limestone, mainly in coastal communities. In hair-type *H. acutangula* resembles the inland species *H. glauca*. Finally, although occurring in isolated, compact communities, the plants seem to be distinct, without a stoloniferous rootstock, resembling in this respect and in general habit, *H. uncatipila*. Overall it seems likely that *H. acutangula* represents an independent line of development from the core of the complex, and may provide a link between this and the complex centred around *H. exalata*.

As mentioned earlier, the species of the *H. exalata* group are (with 3 exceptions) opposite-leaved and comprise less than half of the genus. The species with opposite leaves were the subject of an intensive genetical and morphological study by Forde (1964), and the results of the present study agree well with her conclusions.

In this group the species *H. exalata* occupies a central position analogous to that of *H. aspera* in the other part of the genus. *H. exalata*, confined to coastal eastern and south-eastern Australia, is divided into 2 clearly defined subspecies on morphological and distributional criteria. The northern subspecies (*velutina*) is distinguished from subspecies *exalata* by its relatively narrower leaves and dense velvety tomentum. *H. stricta* is superficially very similar to subsp. *velutina* but differs in leaf (fewer teeth, margins revolute) and hair (more sparse, coarser) characters. The distributional range of the two taxa overlaps in part. *H. serra* is also very closely allied to the *H. exalata-H. stricta* group but differs from it in its 2-locular ovary and fruit. It is also the only species of this opposite-leaved group known to possess a stoloniferous rootstock (as occurs in *H. aspera* and associated species), but the presence of this character in, for example, *H. exalata* or *H. stricta* is not ruled out, as little is known of their rootstocks.

H. erecta, of New Zealand and nearby islands, is very close to *H. exalata* in habit, fruit, flower and hair characteristics, but differs in its petiolate, usually smaller, leaves and habitat preferences. While *H. exalata* is usually found in climax or subclimax natural vegetation along riverbanks, *H. erecta* is a weedy species of disturbed habitats, and is found in such places as abandoned cultivation plots and roadsides. *H. exalata* gives the impression of an old established species, perhaps relict as judged by its rarity and disjunct distribution, while *H. erecta* seems to be a recent, colonising, still expanding and diversifying species. It is not difficult to visualise the origin of the Juan Fernandez species (*H. masafuerana* and *H. masatierrana*) from *H. erecta*. Indeed, it is only with difficulty that the three species can be distinguished. *H. stokesii* also belongs to this group of species. Superficially it closely resembles *H. erecta*, but is distinguished from this species, and from *H. masafuerana* and *H. masatierrana*, by its long peduncles and pedicels and bilocular, tetrandrous flowers.

H. eichleri presents some difficulty in determination of its place in this scheme. In its fruit and leaf characters it resembles to some extent *H. exalata* subsp. *exalata*, and the distributional areas of these two taxa are adjacent. In hair type, habit and habitat preference *H. eichleri* resembles *H. acutangula*, and also adjoins that species in range, but differs in leaf arrangement. The tendency for one locule of the floral ovary to abort in the formation of the fruit is unique to *H. eichleri* among all species of *Haloragis*. *H. eichleri* is probably best considered as representing, with *H. acutangula*, a connecting link between species centred around *H. aspera* and the *H. exalata* group.

The only opposite-leaved species still to be considered is the type of the genus, *H. prostrata*. Schindler placed this species near *H. platycarpa*, with which it has nothing in common except the shape of its fruit. However, *H. prostrata* has no obvious links with any of the species of the *H. exalata* group either, except for its opposite leaves. In its habitat preference (sandy shores) and distribution (New Caledonia and nearby islands) it is unique for the genus, but in both of these attributes comes closest to *H. erecta*. Tentatively, *H. prostrata* is placed near *H. erecta* and *H. exalata*, but more information is needed about this species.

The last three species to be considered, *H. odontocarpa*, *H. gossei* and *H. trigonocarpa*, form a close-knit group of somewhat uncertain affinity. All three are annual (ephemeral) species of arid or semi-arid inland habitats, often growing on or associated with deep sandy soils, and all three have $\pm$ fleshy, petiolate, bluntly toothed leaves and (with the exception of *H. odontocarpa* f. *rugosa*) winged fruits. The 4-merous flowers and fruits of *H. odontocarpa* are reduced to 3-merous flowers and fruits in the other two species, although occasional fruits of *H. gossei* are 4-merous. The fruit of *H. gossei* closely

resembles that of *H. odontocarpa* in size, form and texture of the wings, while that of *H. trigonocarpa* has more elaborate wings and a strongly woody nature. When this is added to the distributional patterns (*H. odontocarpa* and *H. gossei* are widespread throughout central Australia, *H. trigonocarpa* is localised near Kalgoorlie) the latter species seems to represent the most derived of the three. Thus a series *H. odontocarpa*→*H. gossei*→*H. trigonocarpa* can be envisaged, but where this impinges on the rest of the genus is uncertain. Some similarity in leaf and fruit morphology and a preference for sandy soils suggest a possible link between *H. odontocarpa* and *H. eichleri*, and this is strengthened by the tendency in *H. eichleri* for the upper leaves to become alternate, and for the fruit to become falsely 3-merous (reminiscent of *H. gossei* and *H. trigonocarpa*). On the other hand the trio under discussion share their winged fruits only with *H. acutangula* (the extra-Australian species aside), and this species also has alternate leaves and a preference for sandy soils. Overall, it appears that the *H. odontocarpa-H. gossei-H. trigonocarpa* group represents an offshoot from the genus, which has become considerably modified to conditions in arid sandy habitats, and has as its closest allies *H. acutangula* and *H. eichleri*.

Viewing the genus as a whole, a number of trends can be distinguished. Although in this genus and in the family as a whole the flowers and fruits are typically 4-merous, there are at least five distinct lines of development leading to a reduction in number of parts, viz. *H. exalata-H. serra, H. exalata* (*-H. eichleri*)*-H. trigonocarpa, H. aspera* (*-H. aculeolata*)*-H. scoparia, H. heterophylla-H. digyna* and *H. heterophylla-H. brownii.* Schindler segregated all species showing reduction to the 2-3-merous condition into 3 subsections (Digynium, Meionectes and Trihalorrhagis) of *Haloragis* Sect. Pleianthus (= *Haloragis s. str.*). This resulted in the separation of closely related species such as *H. brownii* and *H. tenuifolia* and the aggregation of such diverse species as *H. digyna, H. serra* and *H. scoparia.* In the present study the reduction process is considered to have occurred several times, and given rise to several parallel lines of development, all of which can be traced back to related 4-merous species.

Another distinct trend in the genus is from an opposite (i.e. decussate)-leaved state to an alternate (i.e. spiral)-leaved state. Species such as *H. exalata, H. erecta, H. masafuerana* and *H. masatierrana* have entirely opposite leaves, and in *H. prostrata* the lower primary bracts are also opposite, although in the other species they are alternate. In *H. eichleri* the leaves are usually opposite, although on some branches the upper leaves are alternate. The species of the *H. aspera* group are all basically alternate-leaved, although in some species (e.g. *H. heterophylla*) occasional plants are wholly or partly opposite-leaved, while in others the first 2-8 seedling leaves may be opposite and the others alternate (e.g. *H. aspera, H. gossei*).

The third major trend that can be traced through the genus is from ± woody plants to herbaceous plants. Although it is difficult to place some species into either a "woody" or "non woody" category, some generalisations can be made. The *H. exalata* group contains mainly "woody" species (the possible exceptions being *H. prostrata* and *H. stricta*) characterised by a well-developed branch system in which the lower branches are perennial and woody and only the flowering branches die back each year, while the *H. aspera* group tends to consist mainly of "non woody" species (exceptions being *H. acutangula* and *H. uncatipila*) in which the stems are all more or less herbaceous and die back to ground level after flowering.

Of these major trends, the woody/herbaceous and opposite/alternate-leaved characteristics are very well correlated. In general, the woodier plants have opposite leaves and the herbaceous plants have alternate leaves. The third trend, from 4-merous to 2-3-merous, is not as well correlated with the other two as they are with each other, but it seems that the herbaceous, alternate-leaved species have a greater tendency towards fewer floral parts.

In any discussion of primitive and derived characters there is usually the difficulty of interpreting the direction of trends. With the characters described above it does seem possible to decide with a fair degree of certainty on the direction in which the series should be read. The reduction in the number of parts in some species is almost certainly a derived condition, when it is considered that those species showing this reduction have, in general, little else in common, while the 4-merous species are closely inter-related. In addition, species of all genera of Haloragaceae (except *Proserpinaca*) are predominantly 4-merous. The direction of the woody versus herbaceous tendencies is harder to determine, but it is generally agreed (e.g. Takhtajan, 1969) that the herbaceous condition is derived. As Haloragaceae is a relatively advanced family there would be the possibility of a previous woody to herbaceous trend being reversed, yet in support of the general principle, in *Haloragis* the species showing the herbaceous character at its most pronounced (i.e. the annuals) are those growing in the most extreme habitats (e.g.

H. brownii, an aquatic; *H. odontocarpa, H. gossei, H. trigonocarpa*, desert ephemerals). Finally, the leaf arrangement series can be read with equal justification in either direction, but the appearance of rare opposite-leaved specimens of otherwise alternate-leaved species, but not the reverse, suggests that the opposite-leaved condition is perhaps most likely to be primitive in this group.

If the three trends are read in the directions suggested, then the *H. exalata* group, which consists predominantly of species which are woody, have opposite leaves, 4-merous flowers and fruits, represents the more primitive elements of the genus, while the *H. aspera* group, particularly species such as *H. brownii, H. gossei* and *H. digyna*, is the more derived one.

Genus HALORAGODENDRON

As most of the species of this new genus have been described since Bentham's treatment of the genus in Flora Australiensis (1864) and two of them since Schindler's treatment (1905), the literature contains little discussion of their relationships. The type species, however, was one of the first '*Haloragis*' to be described, and appears in most accounts of the family.

Haloragis racemosa was described by Labillardiere in 1805 from south-western Western Australia. In 1828 A. P. de Candolle transferred the species to *Cercodia* on the basis of its 4-winged fruits and shrubby habit. The only other species of *Cercodia* was the New Zealand *C. erecta*. Subsequent authors, who almost invariably included *Cercodia* and *Gonocarpus* in *Haloragis*, after R. Brown (1814), considered the species under *Haloragis*. Bentham (1864) placed *H. racemosa* in his series Oppositifoliae (leaves opposite, primary bracts alternate) next to *H. alata* (which encompassed the present *H. erecta* and *H. exalata*). In this judgment, Bentham's treatment agreed with that of de Candolle.

Schindler (1904) recognised a similarity between the winged fruits of *Haloragis trigonocarpa, H. gossei, H. stricta* (?), *H. racemosa* and *Glischrocaryon* ('*Loudonia*'), but kept the genera separate and placed the *Haloragis* species in different subsections of his Section Pleianthus. *H. erecta* went into subsection *Cercodia* while *H. racemosa* was part of subsection *Spongiocarpus*. This latter subsection contained a curious assortment of species, and formed a dumping ground for several species of uncertain (in Schindler's opinion) affinity. *H. monosperma, H. racemosa* and *H. baeuerlenii* (as var. β of *H. racemosa)* comprised half of the subsection, and these are the species that are removed from genus *Haloragis* in the present treatment to form the backbone of *Haloragodendron* (*H. lucasii* and *H. glandulosum* were unknown in 1904). The fourth species of the subsection was *H. stricta*, included probably on account of its opposite leaves. As discussed elsewhere, this species is a true *Haloragis* closely related to *H. exalata* subsp. *velutina*. The final two species, *H. paniculata* and *H. lanceolata* were included here as plants unknown to Schindler, but considered by him to belong in Section Pleianthus. In the present treatment they are considered to be species of *Gonocarpus*.

The close affinity, already noted by Schindler, between *H. monosperma, H. racemosa* and *H. baeuerlenii*, and the relationship of these with the subsequently described species *H. lucasii* and *H. glandulosum* led to the segregation of all five from *Haloragis* to form the new genus *Haloragodendron* in the present study. The species of *Haloragodendron* are characterised by their woody, shrub or small tree habit, their determinate inflorescences with opposite primary bracts, navicular or $\pm$ planar petals, apiculate anthers, and their 4-locular, 4-ovuled ovaries which form 1-seeded fruits by the displacement of the $\pm$ solid but flexible septa. In contrast, the species of *Haloragis* are usually herbaceous or woody only at the base of the plant (never as robust as *Haloragodendron*), have indeterminate inflorescences with alternate primary bracts, hooded petals, non-apiculate anthers, and their (usually) 4-locular ovaries have (potentially) one seed in each locule, but even if one or more seeds do not develop, the septa are not displaced, and the empty locules reach full size.

In many respects, *Haloragodendron* has more in common with *Glischrocaryon* than with *Haloragis*. *Glischrocaryon* species are herbaceous, or woody only at the base, have determinate inflorescences with alternate primary bracts, navicular petals, apiculate anthers, and no septa. A single seed, occupying the whole fruit, develops from the four ovules. Whereas the leaves of *Haloragodendron* are all opposite, the leaves of all species of *Glischrocaryon* are alternate, while in *Haloragis* the leaves may be opposite (*H. exalata* group) or alternate (*H. aspera* group). Both *Haloragodendron* and *Glischrocaryon* show the phenomenon of juvenile leaf forms, which are unknown in other genera. Praglowski (1970) found that the pollen of the species of *Haloragodendron* and *Glischrocaryon* investigated by him was almost identical, and distinct from all other members of Haloragaceae.

Taking all of these characters into account, it appears that *Haloragodendron* comes closest to *Glischrocaryon* in affinity, but the differences in leaf and primary bract arrangement, habit, and septum morphology do not support the suggestion of Praglowski (1970) to amalgamate the two groups. In these characters *Haloragodendron* shows affinity with *Haloragis* species of the *H. exalata* group.

Within the genus *Haloragodendron,* relationships are more difficult to determine. All five species are narrowly restricted to areas with little or no overlap. The two Western Australian species (*H. racemosum, H. glandulosum)* are separated from the eastern species by about 1900 km, yet the relationships seem to be east-west rather than within the disjunct groups. In its distribution pattern the genus has the appearance of a formerly more widespread group now reduced to five disjunct species. The eastern species all grow at relatively high altitudes in restricted mountainous areas, while the western species occur at or near sea-level.

The two species showing the greatest similarity are *H. racemosum* and *H. baeuerlenii.* Schindler made the latter species a variety of the former, but the geographical isolation as well as such differences as habitat preference and the size and shape of the fruits and size of the leaves, justify the maintenance of the two taxa as distinct species. The other three species seem to be equally distinct, both from the species above, and from each other. In (adult) leaf morphology and habit *H. monospermum* and *H. glandulosum* show some similarity, but the glandular processes of the latter are unparalleled in the family. The fruits of *H. glandulosum* resemble those of *H. baeuerlenii,* while those of *H. monospermum* are similar to those of *H. racemosum*, but lack the swollen pericarp of the latter species. Both *H. monospermum* and *H. baeuerlenii* have deeply dissected juvenile leaves. *H. lucasii* is unique in the peculiar twisted nature of the flower buds with the tips of the petals recurved slightly, as in *Glischrocaryon flavescens.* In leaf shape *H. lucasii* comes closest to *H. racemosum* and *H. baeuerlenii.* Of the eastern species, *H. lucasii* grows on sandstone soils while *H. monospermum* and *H. baeuerlenii* occur on granitic soils.

To summarise, *Haloragodendron* is most closely allied to *Glischrocaryon,* but shows some affinity with the *H. exalata* group of *Haloragis.* Within the genus, the only two species to show reasonably close relationships are *H. baeuerlenii* and *H. racemosum;* the others have more or less widely divergent characters and show no pronounced affinities in any direction. The species of *Haloragodendron* may represent the relict descendants of a formerly more widespread group.

Genus GLISCHROCARYON

The type species (*G. roei*) of the genus was described in December 1838, accompanied by a separate generic description. The author (Endlicher) placed the genus in the family Santalaceae. In July 1839, the description was reprinted in Endlicher & Fenzl's Decades. Here, as in the first account, the young fruits lacking petals and anthers were mistaken for female flowers with sterile stamens, and the number of stamens (filaments) was given as twelve instead of eight.

In 1840, Lindley described a second species of this genus under the name *Loudonia*, and considered that its affinities were with Haloragaceae ('Halorageae'). Lindley also suggested that *Haloragis cordigera* and *H. scoparia* should be placed in *Loudonia,* although he failed to make the combinations. This suggestion was taken up by Hereman in Paxton's Bot. Dict. (1868) where the combinations were made. In the present study, these two species are placed in *Gonocarpus* and *Haloragis* respectively. Endlicher recognised the identity of *Loudonia* and *Glischrocaryon*, and in his Genera Plantarum (June 1840) combined the two names, unfortunately maintaining *Loudonia*, the later of the two. In this he was followed by all subsequent authors until the priority of *Glischrocaryon* was pointed out by Orchard (1970).

Relationships within the genus are difficult to determine. *G. flavescens* is somewhat isolated from the others by its larger size, woody habit, large compact inflorescences and navicular petals. The flowers and young fruits are superficially indistinguishable from those of *Haloragodendron racemosum,* but the two can be separated easily on differences in the septa, inflorescence and habit. *G. flavescens* is also distinguished by the wide disjunction in its range between south-western Western Australia and Eyre Peninsula in South Australia. This disjunction (although unaccompanied by marked differentiation), combined with its woody habit and isolated position within the genus could be interpreted as being an indication that *G. flavescens* is a species retaining ancestral characteristics, a view supported by the similarity of its flowers to those of *Haloragodendron.*

Glischrocaryon aureum var. *aureum* matches *G. flavescens* in size and habit, and bears a close similarity in the shape and size of its leaves. It differs in its hooded (not navicular) petals and strongly winged fruits. *G. aureum* var. *aureum* is confined to Western Australia, almost entirely to the Darling Range area near Perth, and is thus a north-western extension of the range of *G. flavescens.* It is therefore not difficult to suspect the derivation of the former from the latter.

In the south-western part of Western Australia, the peculiar species *G. roei* is found, principally near Albany and Esperance. It differs from the species so far discussed in its slender habit, weedy tendencies, unusual swollen fruits, and very much smaller leaves. In its floral characters it very closely resembles *G. aureum* var. *aureum.* The link between *G. roei* and *G. aureum* is forged by the occurrence of *G. aureum* var. *angustifolium* which is almost completely intermediate between the other two taxa. In leaf characteristics, habit and habitat preference *G. aureum* var. *angustifolium* is almost indistinguishable from *G. roei,* but the fruits are strongly 4-winged and (usually) not swollen. There is also a subtle difference in the appearance of the inflorescences (and infructescences) of the two species. The heads of flowers in *G. aureum* are more lax, larger, and probably contain more flowers on average than those of *G. roei* which tend to be more compact. *G. aureum* var. *angustifolium* is widespread in Western Australia, encompassing the ranges of both *G. aureum* var. *aureum* and *G. roei* as well as the area between, and also extends to South Australia. Because of its aggressive weedy nature, distribution and intermediate characteristics, it is here suggested that *G. aureum* var. *angustifolium* may have arisen as the result of hybridisation between *G. roei* and *G. aureum* var. *aureum* and subsequently become more or less stabilised as a distinct taxon. Genetic studies to test this hypothesis would be worthwhile.

The final species in the genus is *G. behrii* which differs from all the others in possessing bimerous flowers and fruits. It extends from western Victoria to Eyre Peninsula in South Australia, and thus has the most easterly range of any species of this genus. At the western end of its range, *G. behrii* co-exists with *G. aureum* var. *angustifolium,* and their similarity in almost all characteristics strongly indicates a probable derivation of the former from the latter by the reduction in number of floral parts. This hypothesis is supported by the relatively large number of collections from Kangaroo Island of plants with predominantly 3-merous flowers and fruits, as well as normal *G. behrii* and *G. aureum* var. *angustifolium.*

In summary, *G. flavescens* is probably the most primitive species in the genus and could provide a link to *Haloragodendron. G. aureum* var. *aureum* is closest to *G. flavescens* and is linked via var. *angustifolium* to *G. roei. G. behrii* can be derived from *G. aureum* var. *angustifolium* by reduction of the floral parts.

Genus MEZIELLA

The single species constituting this genus was described by Nees (1844) as a member of *Gonocarpus.* In 1846, it was transferred to *Haloragis* by Walpers, and in 1905 was segregated by Schindler to form the distinct genus *Meziella.*

The plant is known only from a single Preiss collection made near Albany, Western Australia. The specimens from this collection are now extremely fragmentary and were insufficient for a complete re-examination of the taxon in the present study. The following discussion is based largely on Schindler's description.

M. trifida is a creeping bog plant with trifid leaves, resembling in these respects some *Myriophyllum* species. However, unlike *Myriophyllum,* the *Meziella* leaves have tiny teeth between the lobes, a condition found also in *Proserpinaca,* although there the leaves are pinnatifid.

The sepals of *Meziella* have a large median basal callus (characteristic of *Gonocarpus*), and the petals are reported to be linear-navicular (characteristic of *Haloragodendron* and *Glischrocaryon*). The flowers are bisexual, perfect, and borne singly on the axils of the primary bracts, as in *Gonocarpus* (rarely in *Haloragis*), but the stamens are reduced to 4, that is, half the normal number (cf. *Gonocarpus nodulosus, G. philippinensis, Proserpinaca,* some species of *Laurembergia* and *Myriophyllum*). According to Schindler the ovary is four-locular with four ovules (characteristic of *Haloragis, Haloragodendron* and *Myriophyllum*). Unfortunately, no fruits are available.

Schindler placed the genus between *Haloragis* (including *Gonocarpus* and *Haloragodendron*) and *Laurembergia.* On the basis of the differences in inflorescence, sex distribution, leaf shape and floral

structure, a relationship between *Meziella* and *Laurembergia* seems unlikely. Similarly, the apparent resemblance between *Meziella* and *Myriophyllum* is not supported by the leaf and flower characters of *Meziella*. The agreement in the presence of teeth between the foliar lobes in *Meziella* and *Proserpinaca* may be significant. For biogeographical reasons such a relationship appears unlikely and, judged on overall characteristics, it seems best to assign *Meziella* a position near *Haloragis* until more material is available for a detailed examination.

Genus GONOCARPUS (Fig. 326)

The genus *Gonocarpus* was described by Thunberg (1783, 1784), based on Japanese material of *G. micranthus*. Schreber (1789) and Koenig (1805) considered that the name *Gonocarpus* was too similar to *Conocarpus* (Combretaceae) and proposed the variants *Gonatocarpus* and *Goniocarpus* respectively. Koenig's name for the genus was generally accepted by later authors. Both of these later names, as well as *Linociria* Necker, are illegitimate under the International Code of Botanical Nomenclature (1972).

When Robert Brown described the family Haloragaceae ('Halorageae') he included *Gonocarpus* as a synonym of *Haloragis*. This placement of the genus was followed by all later authors with the exceptions of A. P. de Candolle (1828), Cunningham (1839) and Nees (1844, 1848). In the present study *Gonocarpus* is recognised as distinct from *Haloragis* on the basis of differences in inflorescence structure, septum and pericarp morphology, and the number of seeds per fruit.

In the inflorescence of *Gonocarpus* the flowers (with 1 or 2 exceptions) are solitary in the axils of the primary bracts, whereas in *Haloragis* these bracts subtend dichasia of (1-) 3-15 flowers. In this respect *Gonocarpus* resembles *Proserpinaca, Meziella* and *Myriophyllum*. The weak to absent septa, non-woody pericarp and 1-seeded fruit of *Gonocarpus* provide points of similarity between this genus and *Laurembergia*. *Gonocarpus* shares with *Haloragis* and *Laurembergia* its (usually) scabrous indumentum. The flowers of *Gonocarpus* are usually perfect and bisexual (as in *Haloragis, Meziella, Haloragodendron* and *Glischrocaryon*) but some species show tendencies towards unisexual flowers (e.g. *G. tetragynus*). In features of its wood anatomy *Gonocarpus* is more advanced than *Haloragis, Glischrocaryon* and *Haloragodendron*. Praglowski (1970) found little or no significant difference between the pollen morphology of *Gonocarpus, Haloragis, Laurembergia* and *Proserpinaca*, but major differences between these genera and *Glischrocaryon-Haloragodendron*.

On the basis of the above evidence, a position for *Gonocarpus* close to *Laurembergia* seems to be indicated. While there is some similarity in habit and indumentum between *Gonocarpus* and *Haloragis*, the relationship between these two genera is probably not close.

The species of *Gonocarpus* are, on the whole, not as well defined as those of *Haloragis*, and intermediate specimens indicative of possible hybridisation are known for several species pairs. Several major morphological trends run through the genus, and these form the basis of the discussion of species relationships below.

Most species of *Gonocarpus* have an opposite (decussate) leaf arrangement, but a change to alternate leaves seems to have occurred at least twice, in *G. elatus* and in the *G. cordiger-G. pithyoides-G. simplex* group. The basic fruit ornamentation in the "core" species consists of 8 longitudinal ribs, with 2-3 oblique calluses projecting on either side of the antipetalous ribs. This pattern is changed in other species by deletion of the oblique calluses or by modification of their shape. The arrangement of the primary bracts of the inflorescence has been used in this group in the past as a basis for major subdivision of the genus (Bentham, 1864). In the light of present knowledge, this is no longer practical, but the characteristic is still useful in considerations of broad relationships. Only 4 species have an entirely decussate primary bract arrangement, but several others have their lowermost bracts opposite, grading to an alternate arrangement in the upper part of the inflorescence. The majority of the species, however, have all their primary bracts alternate.

The final trend running through the genus is the reduction of the androecium. This seems to have occurred several times in different lines of development. Several species have an androecium in which one or the other of the staminal whorls (usually the antisepalous whorl) is reduced to staminodes, and in some species this is carried a step further by the complete elimination of one whorl (e.g. *G. philippinensis, G. nodulosus*).

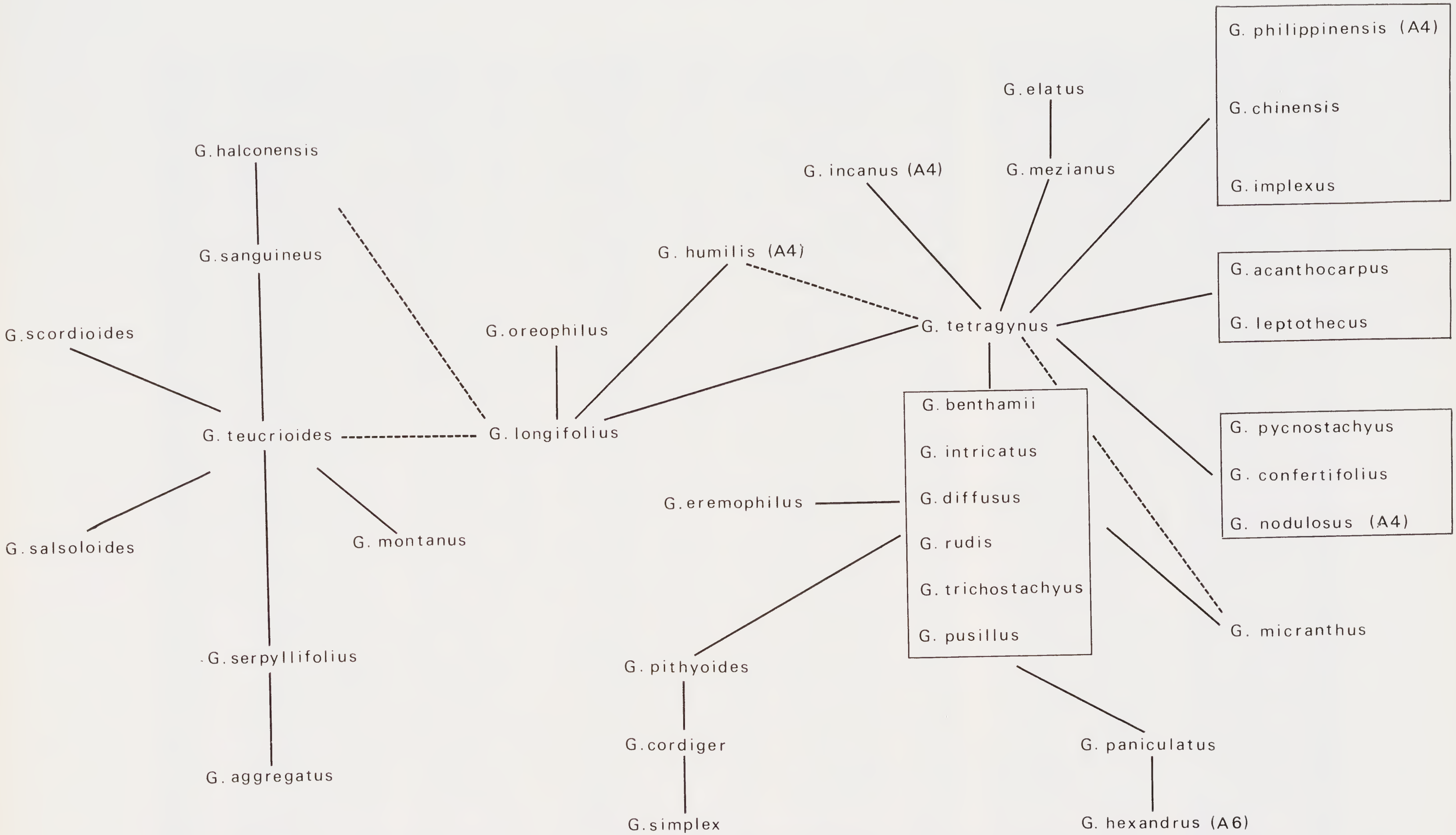


Fig. 326. Schematic representation of relationships in the genus *Gonocarpus*. Solid lines indicate strong affinity, dashed lines indicate uncertain affinity.

As in *Haloragis,* two basic "nodes" of species diversification can be recognised in *Gonocarpus,* in this case centred on *G. teucrioides* and *G. tetragynus*).

G. teucrioides and its allies are distinguished by their combination of opposite (or, rarely, whorled) leaves with opposite primary bracts. In *G. teucrioides* itself only the lower few bracts are opposite, with those in the upper part of the inflorescence becoming alternate. In *G. montanus* a much greater proportion of the bracts are decussate, and in *G. scordioides* all of the primary bracts have this arrangement. All of the above three species have fruits with oblique calluses between the ribs.

In another subgroup of the *G. teucrioides* alliance these oblique calluses are absent. *G. salsoloides* is one of the more unusual species of this subgroup. Its opposite leaves and strictly decussate primary bracts place *G. salsoloides* near *G. teucrioides,* but it seems to have no close relatives. Its preference for marshy habitats (unusual in the genus), narrow leaves, and strong tendency towards dioecy suggests that *G. salsoloides* represents a distinct departure from the core species of this alliance. The other two species of this subgroup are the montane species *G. serpyllifolius* and *G. aggregatus. G. serpyllifolius* has an 8-ribbed fruit with no oblique calluses and strictly decussate primary bracts. Of the two species, it is most closely allied to *G. teucrioides.* In *G. aggregatus* the antisepalous ribs of the fruit are more or less absent and the pericarp is swollen and spongy (as in some species of *Haloragis, Glischrocaryon* and *Haloragodendron*).

A further subgroup of the *G. teucrioides* alliance is made up of the montane Malesian species *G. sanguineus* and *G. halconensis.* These two closely related plants share with *G. teucrioides* their woody, shrub-like habit, but differ sharply in their whorled leaf arrangement (although some forms of *G. halconensis* have some leaves opposite). This type of phyllotaxis is otherwise known only in *G. longifolius* and one specimen of *G. teucrioides.* The fruits of *G. sanguineus* and *G. halconensis* are 8-ribbed with no oblique calluses. The primary bracts of *G. sanguineus* are usually opposite or whorled in the lower part of the inflorescences; in *G. halconensis* they are all alternate. Van der Meijden & Caspers (1971) considered these two taxa conspecific, but they are as distinct from each other as are other members of the genus. *G. halconensis* can be distinguished from *G. sanguineus* by its larger, more widely spaced leaves and much more profusely branched inflorescence. It occurs, for the most part, at lower altitudes than *G. sanguineus,* although the species overlap (and hybridise) in parts of Papua New Guinea, particularly on Mt. Wilhelm.

Two further woody species that seem to have links with the *G. teucrioides* complex are *G. oreophilus* and *G. longifolius.* These two species retain the habit of *G. teucrioides,* but in their strictly alternate primary bracts and generally smaller fruits they more closely approach the *G. tetragynus* alliance.

G. tetragynus is characterised by its opposite leaves, alternate primary bracts, fruits with 8 ribs and oblique calluses and (compared with *G. teucrioides*) less woody habit. It forms the second "node" or focus for diversification in the genus. It links with *G. teucrioides* through such basically woody species as *G. longifolius* and *G. oreophilus. G. humilis* belongs somewhere near this transitional region, resembling as it does a prostrate form of *G. oreophilus* or *G. longifolius,* but with a much more lax inflorescence and a reduced androecium. Its tetrandous flowers are paralleled in the New Zealand species *G. incanus,* but the origin of the latter seems to lie more directly with *G. tetragynus. G. incanus* very closely resembles *G. tetragynus* in leaf shape and texture, habit and indumentum, while *G. humilis* differs from both species in its broad, softer leaves, prostrate habit and lax inflorescence.

G. mezianus of South Australia and western Victoria has in the past been confused with *G. teucrioides,* but more correctly belongs, by virtue of its alternate bracts, with the *G. tetragynus* alliance. It is distinguished from *G. tetragynus* by its broader leaves and glabrous, toothed secondary bracts, and provides a link between that species and *G. elatus.* The latter plant is difficult to place, as its alternate leaves combined with an irregularly verrucose fruit are not matched elsewhere in the genus, but it is known to hybridise on occasion with *G. mezianus.*

Another line of development that can be traced from *G. tetragynus* is that of *G. implexus-G. chinensis-G. philippinensis.* These three species are linked by their slender habit and the strongly developed, white thickened margins of their leaves, primary and secondary bracts, and sepals. *G. implexus* differs from the other two in its broad, soft leaves, and *G. philippinensis* has lost its antipetalous whorl of stamens.

All of the above species of the *G. tetragynus* alliance (with the exception of *G. elatus*) have 8-ribbed fruits with oblique calluses. Three other lines of development can be traced in which there has been modification of the fruit shape and/or ornamentation. The smallest group of the three consists of

G. acanthocarpus and *G. leptothecus*. In these two species the fruit is much longer than in the species discussed above, and instead of oblique calluses between the ribs there are a series of 3-4 ± conical asperities, which in *G. leptothecus* are angular (3-4-faceted) and in *G. acanthocarpus* are smooth.

The second group consists of the species *G. pycnostachyus, G. confertifolius* and *G. nodulosus*. In these plants the fruit is urceolate, with a well-developed ± ribbed neck and irregularly verrucose, bulbous base. *G. pycnostachyus* and *G. confertifolius* are distinguished mainly on leaf characters. *G. nodulosus* lacks an antipetalous whorl of stamens and has dense, short erect hairs at the apex of the ovary between the stamens and styles, a feature unique in the genus.

The final, and largest, of these subgroups might also be considered to be a third "node" of the genus as a whole. It differs from the rest of the *G. tetragynus* group in that the fruits of the plants included are smooth between the 8 longitudinal ribs. The core of the subgroup is made up of 6 species from south-western Western Australia (*G. benthamii, G. intricatus, G. diffusus, G. rudis, G. trichostachyus* and *G. pusillus*), all relatively poorly represented in collections, and differing from each other mainly in minor differences of leaf morphology and indumentum. *G. eremophilus* is probably allied to this group, perhaps most closely to *G. diffusus*. It differs mainly in its longer fruit with glistening papillae on the ribs.

A group of three species (*G. pithyoides, G. cordiger, G. simplex*) with linear or terete, alternate leaves and 8-ribbed fruits are probably also derived from the *G. benthamii* group, although the relationship is not close, and there is no obvious point of departure.

G. micranthus, the type species of the genus, and with a distribution encompassing that of about half of all the other species, has no obvious place in the system outlined above. In its fruit ornamentation, leaf and primary bract arrangement, it comes closest to the *G. benthamii* group, although as these are all endemic Western Australian species separated by 2000 km from *G. micranthus*, it may be better to postulate a parallel and distinct development of *G. micranthus* from *G. tetragynus*.

The final two species of the genus are *G. paniculatus* and *G. hexandrus*. They differ from all the others in that they occasionally (*G. paniculatus*) or usually (*G. hexandrus*) have more than one flower in the axil of each primary bract. In this they approach the condition of *Haloragis*. The septal condition of *G. paniculatus* places it clearly in *Gonocarpus*, and the derivation of this species from the *G. benthamii* group, perhaps via *G. pusillus*, is not hard to envisage. The septa in *G. hexandrus* however, more closely approach those of *Haloragis*. Although incomplete (lacking at the top of the ovary) as is normal in *Gonocarpus*, they are membranous in texture rather than insubstantial ("hyphae-like"). On the balance of characters (habit, fruit development, single-seeded fruit) *G. hexandrus* seems to belong in *Gonocarpus* but it is an anomalous species that requires reinvestigation when more material becomes available.

Genus LAUREMBERGIA

The genus *Laurembergia* was described by Bergius (Sept. 1767) to accommodate the species *L. repens* from Cape Colony, South Africa. Two months later Linnaeus described the same species under the generic name *Serpicula*. A.-L. de Jussieu (1789) favoured the latter name when he combined the two "genera", and he was followed in this choice by all subsequent authors until the priority of *Laurembergia* was pointed out by Schindler (1904, 1905).

Shortly after the description of *Laurembergia*, its relationship to *Haloragis* [*'Cercodia'*] was recognised by e.g. de Jussieu (1789). It was one of the genera placed in the family Haloragaceae at its inception by R. Brown (1814), and he derived it from *Haloragis* via *Myriophyllum* by segregation of the sexes. Schindler (1904, 1905) gave *Laurembergia* a position between *Haloragis-Meziella* and *Proserpinaca*, and divided the genus into two subgenera based on the number of stamens in the male flower (either 4 or 8). This division correlates well with the distribution of the species. Raynal (1965) divided the genus into three subgenera on phytogeographical criteria. Raynal (1965) and van der Meijden & Caspers (1971) reduced the 18 species recognised by Schindler (1905) to four.

In habit and leaf shape, the species of *Laurembergia* most closely resemble *Gonocarpus* or some of the smaller *Haloragis* species. The hooded petals and linear-oblong, non-apiculate anthers of the male

flowers of *Laurembergia* resemble those in the bisexual flowers of *Gonocarpus* and *Haloragis*, and the male flowers of *Myriophyllum*. *Laurembergia* also resembles *Gonocarpus* but not *Haloragis*, in its unilocular ovary which increases in size only very slightly during fruit development.

The separation of the sexes into male and female flowers in *Laurembergia* brings to mind *Myriophyllum*, but there are indications that *Gonocarpus* also has tendencies in this direction (for details, see chapter on diagnostic characters). The inflorescence structure of *Laurembergia*, consisting of (dichasial) fascicles of flowers in the axils of leaf-like primary bracts, most closely agrees with that in *Haloragis*. The scabrous indumentum of several species of *Laurembergia* is another indication of affinity with *Haloragis* and *Gonocarpus*; all the other genera are glabrous. Finally, Praglowski (1970) found that the pollen of *Laurembergia* species closely resembles that of *Myriophyllum*, *Haloragis* (including *Gonocarpus*) and *Proserpinaca*, and Bala Bawa (1969b) reported a close similarity in details of embryology between *Laurembergia*, *Haloragis* and *Myriophyllum*.

On the basis of the evidence above, it seems that *Laurembergia* is most closely allied to *Gonocarpus*, with perhaps some links to *Haloragis*. In its unisexual flowers and semi-aquatic habitat preference, *Laurembergia* may represent a link between *Haloragis* and *Myriophyllum*, but the connection with *Myriophyllum* is tenuous.

Genus PROSERPINACA

This genus of 2-3 eastern American species is difficult to place within Haloragaceae because of a number of features unusual within the family. The anthers are ellipsoid, instead of linear-oblong as in the rest of the family, and have the connective produced into a short apiculum, as occurs also in *Glischrocaryon* and *Haloragodendron*. Praglowski (1970) found that the pollen of *Proserpinaca* more closely resembles that of *Myriophyllum*, *Haloragis* and *Laurembergia*, than that of the former two genera.

The leaves (particularly the submerged ones) of *Proserpinaca* are deeply dissected (cf. *Myriophyllum*, *Meziella* and some *Haloragis* spp.) and have tiny teeth in the sinuses of the lobes, as in *Meziella*. In the loss of one whorl of stamens and the reduction of the petals to vestigial organs, *Proserpinaca* shows a tendency towards unisexual flowers, a feature of *Myriophyllum* and *Laurembergia*. However, a relationship with *Laurembergia* is probably ruled out by the leaf structure and by the solid septa in the ovary of *Proserpinaca*. In this latter character *Proserpinaca* most closely resembles *Haloragis*.

On the basis of all of these characters, *Proserpinaca* appears to occupy a fairly isolated position within the family, possibly providing a link between *Haloragis* and *Myriophyllum*, but further investigations of, e.g. embryology and chromosome number, would be valuable in clarifying its position.

Genus MYRIOPHYLLUM

This genus was described by Linnaeus (1754) and dates from 1753. In many early systems, it was placed with other aquatic genera, such as *Ceratophyllum*, *Callitriche* and *Hippuris*, in families ('Ordo') far removed from other Halorages (e.g. Ara, Adanson (1763), Naiades, de Jussieu (1789)). When the affinity of *Myriophyllum* to genera such as *Cercodia* was recognised, *Hippuris*, *Ceratophyllum* and *Callitriche* were also transferred to Haloragaceae. Only recent evidence made the removal of these last three genera from Haloragaceae necessary.

Schindler (1904, 1905) placed *Myriophyllum* in a separate tribe of his subfamily Haloragoideae, mainly on the basis of its fruit. Unlike the other genera, the fruits of *Myriophyllum* species split at maturity into 2 or 4 single-seeded nutlets or mericarps. However, apart from this unique feature and its lack of both sepals and petals in the female flowers, *Myriophyllum* has a large number of characters in common with the remaining genera of Haloragaceae. In its unisexual flowers *Myriophyllum* resembles *Laurembergia*, and the hooded petals and non-apiculate anthers of its male flowers are closely matched by those of *Haloragis*, *Gonocarpus* and *Laurembergia*. The whorled leaves of the aquatic species of *Myriophyllum*, one of the most distinctive features of the genus, are parallelled by the whorled leaves of e.g. *Gonocarpus sanguineus*, and the shape of the deeply dissected leaves of the aquatic species is matched by species of *Proserpinaca*, *Meziella* and some *Haloragis*.

Praglowski (1970) found that the pollen of *Myriophyllum* very closely resembles *Haloragis* (*Gonocarpus*), *Proserpinaca* and *Laurembergia* in general morphology, and Bala Bawa (1969b) found that *Myriophyllum* is almost indistinguishable from *Haloragis* and *Laurembergia* in details of embryology. The chromosome numbers of most species of *Myriophyllum* (2n = 28) is matched in at least some of the few species of *Haloragis* and *Gonocarpus* for which counts are available.

Thus, despite its reduced flowers and fragmenting fruit, there is no doubt that *Myriophyllum* belongs in Haloragaceae, but within the family its relationships are obscure. In its reduced flowers and generally aquatic nature *Myriophyllum* has some resemblance to *Laurembergia* and *Proserpinaca*, but the affinity is not close. Schindler's segregation of this genus as a distinct tribe seems justified on the presently available evidence, but when more is known about the aquatic species of the family, it may become desirable to segregate *Myriophyllum* even on the rank of subfamily from the other genera of Haloragaceae.

BIBLIOGRAPHY

ADANSON, M.

1763 *Familles des plantes.* Paris (facsimile Lehre, 1966).

AITON, W.

1789 *Hortus Kewensis.* Vol. 2. London.

ALLAN, H. H.

1939 Notes on New Zealand botany. *Trans. R. Soc. N.Z.* 69: 273.

1961 *Flora of New Zealand.* Vol. 1. Wellington.

APLIN, T. E. H.

1968 Cyanogenetic plants of Western Australia. *W. Aust. Dept. Agric. Bull.* 3589: 3-11.

ASTON, H. I.

1973 *Aquatic Plants of Australia.* Carlton.

BAEHNI, C. and C. E. B. BONNER

1948 La vascularisation des fleurs chez les Lopezieae (Onagracees). *Candollea* 11: 305-321.

1949 La vascularisation du tube floral chez les Onagracees. *Candollea* 12: 345-359.

BAILEY, F. M.

1883 *A synopsis of the Queensland flora.* Brisbane.

1896 Contributions to the Queensland flora. *Queensland Dept. Agric. Bull.* 13: 9.

1900 *The Queensland flora.* Vol. 2. Brisbane.

1913 *Comprehensive catalogue of Queensland plants.* Brisbane.

BAILEY, I. W.

1957 The potentialities and limitations of wood anatomy in the study of the phylogeny and classification of the angiosperms. *J. Arn. Arb.* 38: 243-254.

BAILLON, H.

1877 *The natural history of plants.* Vol. 6. London.

BALA BAWA, S.

1969a Embryological studies on the Haloragidaceae. II. *Laurembergia brevipes* Schindl. and a discussion of systematic considerations. *Proc. nat. Inst. Sci. India* (B) 35: 273-290.

1969b Embryological studies on the Haloragidaceae. III. *Myriophyllum intermedium* DC. *Beitr. Biol. Pfl.* 45: 447-464.

BARGHOORN, E. S.

1941 The ontogenetic development and phylogenetic specialization of rays in the xylem of dicotyledons. II. Modification of the multiseriate and uniseriate rays. *Amer. J. Bot.* 28: 273-281.

BARTLING, F. G.

1830 *Ordines naturales plantarum . . .* Göttingen.

BATE-SMITH, E. C.

1962 The phenolic constituents of plants and their taxonomic significance. I. Dicotyledones. *J. Linn. Soc. (Bot.)* 58: 95-173.

BEADLE, N. C. W., O. D. EVANS and R. C. CAROLIN

1972 *Flora of the Sydney Region.* Sydney, Wellington, London, Auckland, Christchurch.

BECCARI, O.

1905 Le palme del genre "Trachycarpus". *Webbia* 1: 41-73.

BENTHAM, G.

1861 *Flora Hongkongensis: A description of the flowering plants and ferns of the island of Hongkong.* London.

1864 *Flora Australiensis.* Vol. 2. London.

BENTHAM, G. and J. D. HOOKER

1865 *Genera plantarum.* Vol. 1. London.

BERGIUS, P. J.

1767 *Descriptiones plantarum ex Capite Bonae Spei . . .* Stockholm.

BEUZENBERG, E. J. and J. B. HAIR

1963 Contributions to a chromosome atlas of the New Zealand flora. 5. Miscellaneous families. *N.Z. J. Bot.* 1: 53-67.

BLACK, J. M.

1914 *In* White, S. A. et al., Scientific notes on an expedition into the interior of Australia, carried out by Captain S. A. White. Section (k), Botany. *Trans. R. Soc. S. Aust.* 38: 460-471.

1915 *In* White, S. A. et al., Scientific notes on an expedition into the north-western regions of South Australia, (j) Botany. *Trans. R. Soc. S. Aust.* 39: 823-842.

1917 Additions to the flora of South Australia, No. 11. *Trans R. Soc. S. Aust.* 41: 41-52.

1917 *In* Waite, E. R. et al. Results of the South Australian Museum expedition to Strzelecki and Cooper Creeks, Sept. & Oct. 1916. (o) Botany. *Trans. R. Soc. S. Aust.* 41: 631-652.

1925 Additions to the flora of South Australia, No. 23. *Trans. R. Soc. S. Aust.* 49: 275.

1926 *Flora of South Australia.* Adelaide.

1935 Additions to the flora of South Australia, No. 33. *Trans R. Soc. S. Aust.* 59: 252-262.

1952 *Flora of South Australia.* 2nd ed. Adelaide.

BLACKALL, W. E. and B. J. GRIEVE

1965 *How to know Western Australian wildflowers.* Vol. 3. Perth.

BLAKE, S. T.

1963 New or noteworthy plants chiefly from Queensland, II. *Proc. R. Soc. Queensland* 73: 61-77.

BLEY, F.

1925 Zur embryologie von *Laurembergia javanica* (Miq.) Schindler. *Diss. Arb. Inst. allg. Bot. Zurich II.* 6: 1-31.

BLUME, C. L.

1856 *Museum botanicum Lugduno-Batavum* . . . Vol. 2. Leiden.

BONNER, C. E. B.

1948 The floral vascular supply in *Epilobium* and related genera. *Candollea* 11: 277-303.

BORGMANN, E.

1964 Anteil der Polyploiden in der Flora des Bismarck-gebirges von Ostneuguinea. *Z. Bot.* 52: 118-172.

BRITTEN, J.

1907 Notes on Halorrhagaceae. *J. Bot.* 45: 135-138.

BROWN, A.

1864 *In* Ascherson, P. F. A., *Flora der Provinz Brandenberg.* Berlin.

BROWN, F.

1935 Flora of south-eastern Polynesia — III. Dicotyledons. *Bull. Bishop Mus.* 130: 1-386.

BROWN, R.

1814 General remarks, geographical and systematical on the botany of Terra Australis, *In* Flinders, M., *A voyage to Terra Australis.* London.

BUCHANAN, J.

1872 On some new species of New Zealand plants. *Trans. N.Z. Inst.* 4: 224-227.

BULLOCK, A. A.

1959 Nomina familiarum conservanda proposita. *Taxon* 8: 154-181.

BURBIDGE, N. and M. GRAY

1970 *Flora of the A.C.T.* Canberra.

CAMBESSEDES, J.

1830 *In* St. Hilaire. *Flora Brasilianae meridionalis.* Vol. 2. Paris.

CAMBIE, R. C., B. F. CAIN and S. LA ROCHE

1961 A New Zealand phytochemical survey. Part 2. Dicotyledons. *N.Z. J. Sci.* 4: 604-663.

CANDOLLE, A. de

1868 *Prodromus systematis naturalis regni vegetabilis* . . . Vol. 16 (2). Paris.

CANDOLLE, A. P. de

1828 *Prodromus systematis naturalis regni vegetabilis* . . . Vol. 3. Paris.

CASPERS, N.

1966 *In* van Steenis, C. G. G. J. and M. M. J. van Balgooy. Pacific plant areas, vol. 2. *Blumea* Suppl. 5: 60-61.

CHEESEMAN, T. F.

1897 On some plants new to the New Zealand flora. *Trans. N.Z. Inst.* 29: 390-391.

1906 *Manual of the New Zealand flora.* Wellington.

1909 Contributions to the flora of New Zealand. *Trans. N.Z. Inst.* 42: 201-203.

1925 *Manual of the New Zealand flora.* 2nd ed. Wellington.

CHIPPENDALE, G. M.

1959 Check list of Central Australian plants. *Trans. R. Soc. S. Aust.* 82: 321-338.

CHOIVENDA, E. and A. VACCARI

1934 Una nuova *Halorrhagis* della Nuova Zelanda. *Atti Soc. nat. Mat. Modena* 65: 148-149.

CHOPRA, R. N. and H. KAUR

1965 Some aspects of the embryology of *Cornus. Phytomorph.* 15: 353-359.

CHUANG, T. I., et al.

1962 Chromosome numbers of the vascular plants of Taiwan I. *Taiwania* 1 (8): 51-56.

CLARKE, C. B.

1878 Halorageae. *In* Hooker, J. D. *Flora of British India.* Vol. 2. London.

CLELAND, W. L.

1888 Caroona Hill (Lake Gillies). *Trans. R. Soc. S. Aust.* 10: 74-79.

COCKAYNE, L.

1909 Report on a botanical survey of Stewart Island. *App. J. House Rep.* (N.Z.)

COLENSO, W.

1886 Newly discovered indigenous plants. *Trans. N.Z. Inst.* 18: 259-260.

1890 A description of some newly discovered phaenogamic plants, being a further contribution towards the making-known the botany of New Zealand. *Trans. N.Z. Inst.* 22: 459-493.

COLLA, L. A.

1824 *Hortus ripulensis seu enumeratio plantarum quae Ripulis coluntur.* Torino.

COOKSON, I. C. and K. M. PIKE

1954 Some dicotyledonous pollen types from Cainozoic deposits in the Australian region. *Aust. J. Bot.* 2: 197-219.

COPELAND, H. F.

1963 Structural notes on the hollies (*Ilex aquilifolium & I. cornuta,* family Aquifoliaceae). *Phytomorph.* 13: 455-464.

CRANWELL, L.

1942 New Zealand pollen studies. I. Key to the pollen grains of families and genera in the native flora. *Rec. Auckland Inst. Mus.* 2: 280-308.

CRONQUIST, A.

1968 *The evolution and classification of flowering plants.* Aylesbury.

CUNNINGHAM, A.

1839 Florae insularum Novae Zelandiae precursor; or a specimen of the botany of the islands of New Zealand. *Ann. Mag. nat. Hist.* 3: 29-30.

CUNNINGHAM, J. L.

1969 Rapid alkaline rehydration of dried plant tissues for histologic study. *Stain Tech.* 44: 243-246.

CURREY, J. E. B. (Editor)

1966 *Reflections on the colony of New South Wales. George Caley.* Melbourne.

CURTIS, W. M.

1956 *The students flora of Tasmania.* Vol. 1. Tasmania.

DAHLGREN, K. V. O.

1916 Zytologische und embryologische studien uber die Reihen Primulales und Plumbaginales. *K. svenska Vetensk. Akad. Handl.* 56: 1-80.

Dalla Torre, C. G. de and H. Harms
1900-1907 *Genera siphonogamarum.* Leipzig.

Davidson, C.
1973 An anatomical and morphological study of Datiscaceae. *Aliso* 8: 49-110.

Davis, G. L.
1966 *Systematic embryology of the Angiosperms.* New York.

Diels, L.
1936 In *Engler's Syllabus der Pflanzenfamilien.* 11th ed. Berlin.

Diels, L. and E. Pritzel
1904 Fragmenta phytographiae Australiae occidentalis. *Bot. Jb.* 35: 444-448.

D:ng Hou
1958 Rhizophoraceae. *Flora Malesiana* 5: 431-493.

Dixon, W. A.
1906 *The plants of New South Wales.* Sydney.

Domin, K.
1929 Beiträge zur Flora und Pflanzengeographie Australiens. *Bibl. bot., Stuttgart* 89: 1034-1036.

Don, G.
1832 *A general history of dichlamydeous plants.* London.

Drake, W. F.
1811 *In* Rees, A., *The cyclopaedia; or universal dictionary of arts, sciences and literature.* Vols. 16, 17. London.

Dumortier, B. C. J.
1829 *Analyse des familles des plantes . . .* Tournay.

Duperrey, L. I.
1827-34 *Voyage autour du Monde . . . la Coquille.* Paris.

Durand, T. and B. D. Jackson
1906 *Index Kewensis.* Suppl. 1. Brussells.

Ehrendorfer, F.
1971 In *Strasburger's Lehrbuch die Botanik für Hochschulen.* 30th ed. Stuttgart.

Eichler, A. W.
1875-1878 *Blüthendiagramme construirt und erläutert.* Leipzig.

Eichler, H.
1965 *Supplement to J. M. Black's Flora of South Australia.* Adelaide.

Endlicher, S. L.
1834 *Atakta botanica.* Wien.
1837 *Genera plantarum secundum ordines naturales disposita.* Wien.
1838 Stirpium australasicarum herbarii Hugeliani decades tres. *Ann. Wien Mus.* 2: 209.
1840 *Genera plantarum secundum ordines naturales disposita.*Wien.
1841 *Enchiridion botanicum . . .* Leipzig.
1842 *Genera plantarum secundum ordines natura'es disposita.* Suppl. 2. Wien.

Erdtman, G.
1943 *An introduction to pollen analysis.* Waltham.
1966 *'Pollen morphology and plant taxonomy. Angiosperms.* New York & London.

Erickson, R.
1969 *The Drummonds of Hawthornden.* Osbourne Park.

Evans, O. D.
1963 Haloragaceae. *In* Beadle, N. C. W., O. D. Evans and R. C. Carolin. *Handbook of the vascular plants of the Sydney district and Blue Mountains.* Armidale.

Ewart, A. J.
1931 *Flora of Victoria.* Melbourne.

EWART, A. J. and O. B. DAVIES

1917 *The flora of the Northern Territory.* Melbourne.

EYDE, R. H.

1966 Systematic anatomy of the flower and fruit of *Corokia. Amer. J. Bot.* 53: 833-847.

1967 The peculiar gynoecial vasculature of Cornaceae and its systematic significance. *Phytomorph.* 17: 172-182.

FEATON, E. H.

1889 *The art album of New Zealand flora.* Vol. 1. London.

FENZL, E.

1837 *In* Endlicher, S. L., E. Fenzl, G. Bentham and H. Schott, *Enumeratio plantarum . . . Hügel.* Wien.

FIELD NATURALISTS SECTION

1885 3rd excursion — Sat. Jan. 24th, 1885, Ambleside. *Trans. R. Soc. S. Aust.* 8: 184-185.

FITZGERALD, W. V.

1918 The botany of the Kimberleys, north-west Australia. *J. Proc. R. Soc. W. Aust.* 3: 102-224.

FORBES, F. B. and W. B. HEMSLEY

1887 An enumeration of all the plants known from China proper, Formosa, Hainan, Corea, the Luchu Archipelago, and the island of Hongkong, together with their distribution and synonymy. *J. Linn. Soc. (Bot.)* 23: 292.

FORDE, M. B.

1964 *Haloragis erecta:* a species complex in evolution. *N.Z. J. Bot.* 2: 425-453.

FORSTER, J. G. A.

1786 *Florulae insularum australium prodromus.* Goettingen.

FORSTER, J. R. and J. G. A. FORSTER

1775 *Characteres generum plantarum, . . .* London.

GADELLA, T. W. J. and E. KLIPHUIS

1963 Chromosome numbers of flowering plants in the Netherlands. *Acta bot. Neerl.* 12: 195-230.

1966 Chromosome numbers of flowering plants in the Netherlands II. *Proc. R. Neth. Acad. Sci.* (C) 69: 541-556.

1968 Chromosome numbers of flowering plants in the Netherlands IV. *Proc. R. Neth. Acad. Sci.* (C) 71: 168-173.

GARDNER, C. A.

1931 *Enumeratio plantarum Australiae occidentalis.* Perth.

1959 *Wildflowers of Western Australia.* Perth.

GAUDICHAUD, C. B.

1830 *Voyage autour du Monde . . . l'Uranie et la Physicienne.* Paris.

GHOSH, M.

1954 The embryology and systematic position of *Trapa bispinosa* Roxb. *Curr. Sci.* 23: 24-26.

GIBBS, L. S.

1917 *A contribution to the phytogeography and flora of the Arfak Mountains &c.* London.

GIBELLI, G. and F. FERRERO

1891a Richerche di anatomia e morfologia allo sviluppo dell'ovulo e del seme della *Trapa natans. Malpighia* 5: 1-64.

1891b Intorno allo sviluppo dell'ovulo e del seme della *Trapa natans. Malpighia* 5: 156-218.

1895 Recherche di anatomia e morfologia intorno allo sviluppo del fiore e del frutto della *Trapa natans. Malpighia* 9: 379-437.

GRAY, A.

1854 *United States exploring expedition,* Vol. 15. *Botany. Phanerogamia.* Philadelphia.

GRAY, S. F.

1821 *A natural arrangement of British plants.* London.

GUILLAUMIN, A.

1911 Plantes phanerogames de la Nouvelle-Caledonie. *Ann. Mus. colon. Marseille* (II) 9: 141.

1914 Contributions a la flore d'Extreme-Orient: Haloragacees, Hippuridacees, Callitrichacees. *Bull. Soc. bot. Fr.* 61: 8-12.

1920 Haloragacees. *in,* Lecomte, H. *Flore generale de l'Indo-Chine* 2: 714-718.

1948 *Flore analytique et synoptique de la Nouvelle-Caledonie. Phanerogames.* Paris.

GUILLAUMIN, A. and G. BEAUVISAGE

1914 *Species Montrouzieranae seu enumeratio plantarum in Nova Caledonia terrisque adjacentibus a R.P. Montrouzier lectarum.* Lyon.

HAIR, J. B.

1966 Biosystematics of the New Zealand flora 1945-64. *N.Z. J. Bot.* 4: 559-595.

HAIR, J. B. and E. J. BEUZENBERG

1959 Contributions to a chromosome atlas of the New Zealand flora, 2. *N.Z. J. Sci.* 2: 148-156.

HALLIER, H.

1912 L'origine et le systeme phyletique des angiospermes exposes a l'aide de leur abre genealogique. *Arch. neerl. Sci.* (IIIB) 1: 146-234.

HAMILTON, W.

1825 *Prodromus plantarum Indiae occidentalis . . .* London.

HARADA, I.

1952 Chromosome studies of some dicotyledonous water plants. *Jap. J. Genet.* 27: 117-120.

HEGI, G.

1925 *Illustrierte flora von Mittel-Europa.* Vol. 5. Munich.

1931 ibid. Vol. 7. Munich.

HEGNAUER, R.

1958 *Pharm. Weekblad.* 93: 801, n.v.

1966 *Chemotaxonomie der Pflanzen.* Vol. 4. Basel and Stuttgart.

HEREMAN, S. (Editor)

1868 *Paxton's botanical dictionary.* London.

HIEPKO, P.

1969 Von J. R. und G. Forster gesammelte Pflanzen im Herbar Willdenow in Berlin. *Willdenowia* 5: 279-294.

HOOGLAND, R. D.

1958 The alpine flora of Mount Wilhelm (New Guinea), *Blumea* Suppl. 4: 220-238.

HOOKER, J. D.

1847 Florae Tasmaniae spicilegium: or contributions towards a flora of Van Dieman's Land. *Lond. J. Bot.* 6: 461-479.

1852 *The botany of the antarctic voyage of H.M. discovery ships Erebus and Terror in the years 1839-1843. II. Flora Novae-Zelandiae.* 1. London.

1855 ibid. *II. Flora Novae-Zelandiae.* 2. London.

1856 ibid. *III. Flora Tasmaniae.* 1. London.

1859 ibid. *III. Flora Tasmaniae.* 2. London.

1867 *Handbook of the New Zealand flora.* London.

HOOKER, W. J.

1840a *Icones plantarum.* Vol. 3. London.

1840b ibid. Vol. 4. London.

1842 Further botanical intelligence from Swan River. *Lond. J. Bot.* 1: 396.

1843 *Icones plantarum.* Vol. 6. London.

HOOKER, W. J. and G. A. W. ARNOTT

1833 Contributions towards a flora of South America and the islands of the Pacific. *Bot. Misc.* 3: 129-212.

HORNE, A. S.

1914 A contribution to the study of the evolution of the flower, with special reference to the Hamamelidaceae, Caprifoliaceae and Cornaceae. *Trans. Linn. Soc. (Bot.)* (II) 8: 239-309.

HOSAKAWA, T.

1940 A preliminary note on the botanical trip to Mt. Apo, Mindanao, Philippines. *Trans. nat. Hist. Soc. Formosa* 30: 335-336.

HSU, C.-C.

1968 Preliminary chromosome studies on the vascular plants of Taiwan (II). *Taiwania* 14: 11-27.

HUNDLEY, H. G. and CHIT KO KO

1961 *List of shrubs, herbs and principal climbers etc. recorded from Burma with vernacular names.* 3rd ed. Rangoon.

HUTCHINSON, J.

1959 *The families of flowering plants.* Vol. 1. 2nd ed. Oxford.

1969 *Evolution and phylogeny of flowering plants.* London and New York.

ISHIKAWA, M.

1918 Studies on the embryosac and fertilization in *Oenothera. Ann. Bot.* 32: 279-317.

JACK, W.

1822 *Malayan miscellanies.* Vol. 2. Bencoolen.

JACKSON, B. D.

1928 *A glossary of botanic terms.* 4th ed. London.

JACKSON, G.

1933 A study of the carpophore of the Umbelliferae. *Amer. J. Bot.* 20: 121-144.

JACQUIN, N. J. von

1781-1782 *Miscellanea austriaca ad botanicum, chemiam, et historiam naturalem spectantia, cum figuris partim coloratis.* Wien.

1783 *Icones plantarum rariorum.* Wien.

1798 *Plantarum rariorum horti caesari Schoenbrunnensis descriptiones et icones.* Vol. 1. Wien.

JOERGENSEN, C. A.

1923 Studies on Callitrichaceae. *Bot. Tiddskr.* 38: 81-126.

1925 Zur Frage der systematischen Stellung der Callitrichaceen. *Jb. wiss. Bot.* 64: 440-442.

JOERGENSEN, C. A., T. SORENSEN and M. WESTERGAARD

1958 The flowering plants of Greenland. A taxonomical and cytological survey. *Dansk. Vid. Selsk. Biol. Skr.* 9: 1-172.

JOHANSEN, D. A.

1940 *Plant microtechnique.* New York and London.

JUEL, H. O.

1910 *Cymorium* und *Hippuris. Svensk. Bot. Tidskr.* 4: 151-159.

1911 Studien über die Entwicklungsgeschichte von *Hippuris vulgaris. Nova Acta Soc. Sci. upsal.* 2: 1-26.

JUSSIEU, A.-L. de

1789 *Genera plantarum . . .* Paris (facsimile, Weinheim, 1964).

1805 Observations on the natural order of the Onagrariae. *Ann. Bot.* 1: 530-541.

1817 In *Dictionnaire des sciences naturelles.* 5: 441-442.

KANEHIRA, R.

1935 An enumeration of Micronesian plants. *J. Dept. Agr. Kyushu Univ.* 4: 237-464.

KAPIL, R. N.

1962 Some recent examples of the value of embryology in relation to taxonomy. *Bull. Bot. Surv. India* 4: 57-66.

KAPIL, R. N. and S. BALA BAWA

1968 Embryological studies on the Haloragidaceae. I. *Haloragis colensoi* Skottsb. *Bot. Not.* 121: 11-28.

KAPIL, R. N. and P. R. MOHANA RAO

1966 Embryology and systematic position of *Theligonum* Linn. *Proc. nat. Inst. Sci. India.* (B) 32: 218-232.

KELLERMANN, W. A.

1881 Die Entwicklungsgeschichte von *Gunnera chilensis. Diss. Zurich n.v.*

KEMPE, J.

1880 Plants indigenous to the neighbourhood of Hermannsberg. *Trans. R. Soc. S. Aust.* 3: 129-137.

KENG, H.

1970 *Haloragis chinensis* on Singapore Island. *Malay. Nat. J.* 23: 123-124.

KIRK, T.

1877 Descriptions of new plants. *Trans. N.Z. Inst.* 9: 547-552.

1899 *The students flora of New Zealand.* Wellington.

KOCH, M.

1898 A list of plants collected on Mt. Lyndhurst Run, S. Australia. *Trans. R. Soc. S. Aust.* 22: 101-118.

KOENIG, K. D. E.

1805 Some observations on the preceding paper, with the description of two species of *Goniocarpus. Ann. Bot.* 1: 542-548.

KRIBS, D. A.

1935 Salient lines of structural specialization in the wood rays of dicotyledons. *Bot. Gaz.* 96: 547-557.

KUNTH, C. S.

1838 *Flora berolinensis* . . . Berlin. *n.v.*

1841 *Enumeratio plantarum* . . . Vol. 3. Stuttgart & Tubingen.

LABILLARDIERE, J. J.

1804-1805 *Novae Hollandiae plantarum specimen.* Vol. 1. Paris.

1806 ibid. Vol. 2. Paris.

LAM, H. J.

1945 Contributions to our knowledge of the flora of the Celebes (coll. C. Monod de Froideville) and of some other Malaysian islands. *Blumea* 5: 554-599.

LAMARCK, J. B. A. P. M. de

1785 *Encyclopedie methodique botanique.* Vol. 1. Paris.

1797 *Tableau encyclopedique et methodique des trois regnes de la nature. Botanique.* Vol. 1. Paris.

LANJOUW, J. and F. A. STAFLEU

1964 Index herbariorum. Part 1. The herbaria of the world. 5th ed. *Reg. Veg.* 31: 1-249.

LARSEN, K.

1965 I.O.P.B. chromosome number report. IV. *Taxon* 14: 86-92.

1966 Studies on the flora of Thailand. 40. Cytology of vascular plants II. *Dansk. bot. Ark.* 23: 375-399.

LAWRENCE, G. H. M.

1951 *Taxonomy of vascular plants.* New York.

LEMAOUT, E. and J. DECAISNE

1873 *A general system of botany.* (Transl. Mrs. Hooker). London.

L'HERITIER de BRUTELLE, C.-L.

1788 *Stirpes novae aut minus cognitae,* . . . Paris.

LINDLEY, J.

1830 *An introduction to the natural system of botany.* London.

1836 ibid. 2nd ed. London.

1840 *A sketch of the vegetation of the Swan River Colony.* (Append. Bot. Reg.). London.

1846 *The vegetable kingdom;* . . . London.

1853 ibid. 3rd ed. London.

LINNAEUS, C.

1753 *Species plantarum.* Stockholm. (Facsimile, London, 1957-59).

1754 *Genera plantarum.* 5th ed. Stockholm. (Facsimile, Weinheim, 1960).

1767-1771 *Mantissa plantarum.* Stockholm. (Facsimile, Weinheim, 1961).

LINNAEUS, C. von (filius)

1781 *Supplementum plantarum systematis vegetabilium* . . . Braunschweig. (Facsimile, Tokyo, 1938).

LOUDON, J. C.

1855 *Encyclopaedia of plants.* (Mrs. Loudon, Editor). London.

LOUREIRO, J. de

1790 *Flora cochinchinensis: sistens plantas in regno Cochinchina nascentes* . . . Lisbon.

LÖVE, A.

1954 Cytotaxonomic remarks on some American species of circumpolar taxa. *Svensk. bot. Tidskr.* 48: 211-232.

LÖVE, A. and D. LÖVE

1958 The American element in the flora of the British Isles. *Bot. Not.* 111: 376-388.

LÖVE, A. and J. C. RITCHIE

1966 Chromosome numbers from central Canada. *Canad. J. Bot.* 44: 429-439.

MAIDEN, J. H.

1910 Records of the earlier French botanists as regards Australian plants. *Proc. R. Soc. New South Wales* 44: 123-155.

MAIDEN, J. H. and E. BETCHE

1906 A review of the N.S.W. species of Halorrhagaceae as described in Prof. A. K. Schindler's monograph (1905); with the description of a new species. *Proc. Linn. Soc. New South Wales* 31: 393-398.

1909 Notes from the Botanic Gardens, Sydney. No. 14. *Proc. Linn. Soc. New South Wales* 34: 357-369.

1916 *A census of New South Wales plants.* Sydney.

MANSFELD, R.

1927 Die Halorrhagaceen von Papuasien. *Bot. Jb.* 61: 26-27.

MEISNER, C. F.

1838-1841 *Plantarum vascularium genera secundum ordines naturales . . .* Leipzig.

MELCHIOR, H.

1964 In *Engler's Syllabus der Pflanzenfamilien.* Vol. 2. 12th ed. Berlin.

MELVILLE, R.

1962 A new theory of the angiosperm flower. I. The gynoecium. *Kew Bull.* 16: 1-50.

1963 ibid. II. The androecium. *Kew Bull.* 17: 1-63.

MERRILL, E. D.

1906 New or noteworthy Philippine plants. *Philipp. J. Sci.* Suppl. 1: 216-217.

1907 The flora of Mount Halcon, Mindoro. *Philipp. J. Sci. (Bot.)* 2: 288-289.

1917 Contribution to our knowledge of the flora of Borneo. *J. Str. Br. As. Soc.* 76: 75-117.

1923 *An enumeration of Philippine plants.* Vol. 3. Manilla.

1935 A commentary on Loureiro's "Flora Cochinchinensis". *Trans. Amer. Phil. Soc.* n.s. 24: 1-445.

MERRILL, E. D. and L. M. PERRY

1942 Plantae Papuanae Archiboldianae. X. *J. Arn. Arbor.* 23: 383-416.

1948 Notes on some Papuan collections of Mary Strong Clemens. *J. Arn. Arbor.* 29: 161-162.

METCALF, C. R. and L. CHALK

1950 *Anatomy of the dicotyledons.* Vols. 1 & 2. Oxford.

MIKI, S.

1959 Evolution of *Trapa* from ancestral *Lythrum* through *Hemitrapa. Proc. imp. Acad. Japan.* 35: 289-294.

MIRANDE, M.

1913 Sur quelques plantes nouvelles a acid cyanhydrique. *C.R. Soc. Biol., Paris* 75: 434-436.

MITCHELL, J.

1748 *Genera plantarum Virginica. Nuremberg Academia Caesarea Leopoldino-Carolina Germanica naturae curiosorum: Ephemerides n.v.*

MITCHELL, T. L.

1848 *Journal of an expedition into the interior of tropical Australia.* London.

MODILEWSKI, J.

1908 Zur Embryobildung von *Gunnera chilensis. Ber. dtsch. bot. Ges.* 26: 550-556.

MONTROUZIER, X.

1860 Flore de l'ile Art (pres de la Nouvelle Caledonie). *Mem. Acad. Sci. Belles-Lett. Lyon* 10: 173-254.

MOORE, C.

1893 *Handbook of the flora of New South Wales.* Sydney.

MOORE, D. M.

1960 Chromosome numbers of flowering plants from Macquarie Island. *Bot. Not.* 113: 185-191.

MOORE, S. LeM.

1897 The camel fodder plants of Western Australia. *J. Bot.* 35: 165.

MOORE, S.

1899 The botanical results of a journey into the interior of Western Australia. *J. Linn. Soc. (Bot.)* 34: 190.

MUELLER, F. von

1853a The flora of South Australia, displayed in its fundamental features, and comparatively. *Hook. J. Bot.* 5: 65-72.

1853b Diagnoses et descriptiones plantarum novarum, quas in Nova Hollandia australi praecipue in regionibus interioribus. *Linnaea* 25: 367-445.

1855 Description of new Australian plants chiefly from the colony of Victoria. *Trans. Vict. Inst.* 1: 114-135.

1859 *Fragmenta phytographiae Australiae.* Vol. 1. Melbourne.

1862 ibid. Vol. 3. Melbourne.

1863 ibid. Vol. 4. Melbourne.

1874 ibid. Vol. 8. Melbourne.

1876 ibid. Vol. 10. Melbourne.

1878 ibid. Vol. 11. Melbourne.

1882 *Systematic census of Australian plants.* Vol. 1. Melbourne.

1885a Record of a remarkable *Haloragis* from New South Wales. *Proc. Linn. Soc. New South Wales* 10: 197-198.

1885b *Key to the system of Victorian plants.* Vol. 2. Melbourne.

1887 Plants collected in the vicinity of the Mulligan River by Mr. W. H. Cornish during his survey expedition in 1885. *Trans. R. Soc. S. Aust.* 9: 213-215.

1887-1888 *Key to the system of Victorian plants.* Vol. 1. Melbourne.

1888 Remarks on a new Victorian *Haloragis,* and on the occurrence of the genus *Pluchea* within the Victorian territory. *Trans. R. Soc. Vict.* 24: 132-137.

1889 *Second systematic census of Australian plants.* Vol. 1. Melbourne.

MUELLER, F. von and R. TATE

1890 List of plants collected during Mr. Tietkin's expedition into Central Australia, 1889. *Trans. R. Soc. S. Aust.* 13: 94-106.

1896 Phanerogams and vascular cryptogams. *Trans. R. Soc. S. Aust.* 16: 333-383.

MURRAY, A.

1780 Illustrationes stirpium novarum et rariorum Horti R. Botan. *Comm. Goett.* 3: 3-8.

NAGARAJ, M. and B. H. M. NIJALINGAPPA

1967 Embryological studies in *Myriophyllum intermedium* DC. *Proc. Indian Acad. Sci.* (B) 65: 210-220.

1974 Embryological studies in *Laurembergia hirsuta. Bot. Gaz.* 135: 19-28.

NECKER, N. J. de

1790 *Elementa botanica genera genuina, . . .* Neuwied.

NEES von ESENBECK, T. F. L.

1844 *In* Lehmann, J. G. C. *Plantae Preissianae, . . .* Vol. 1. Hamburg.

1848 ibid. Vol. 2. Hamburg.

OHWI, J.

1965 *Flora of Japan* (English edition, Meyer and Walker, Editors). Washington.

ORCHARD, A. E.

1970 *Glischrocaryon:* the correct name for *Loudonia.* (Haloragaceae). *Taxon* 19: 823-824.

1972 *Taxonomic revisions in the family Haloragaceae R. Br.* Adelaide University, unpublished thesis.

OSTENFELD, C. H.

1921 Contributions to West Australian botany. III. Additions and notes to the flora of extra tropical W. Australia. *K. danske Vidensk. Selsk., Biol. Medd.* 3 (1921) 1-144.

PACKER, J. G.

1964 Chromosome numbers and taxonomic notes on Western Canadian and Arctic plants. *Canad. J. Bot.* 42: 473-494.

PARKER, R. N.

1931 Additamenta ad floram Burmanicum. 1. *Fedde Repert.* 29: 104-105.

PATEL, R. N.

1973 Wood anatomy of the dicotyledons indigenous to New Zealand 1. Cornaceae. *N.Z. J. Bot.* 11: 3-23.

PERRIER de la BATHIE, H.

1952 Une "Rose de Jericho" a Madagascar. *Notul. Syst.* 14: 305-306.

PETERSEN, O. G.

1893 Halorrhagidaceae, *in*, Engler, H. G. A. and K. A. E. Prantl *Die naturlichen Pflanzenfamilien* III. Vol. 7. Leipzig.

PETRIE, D.

1887 Descriptions of new native plants. *Trans. N.Z. Inst.* 19: 325-326.

PHILIPSON, W. R.

1967 *Griselinia* Forst. fil. Anomaly or link? *N.Z. J. Bot.* 5: 134-165.

POGON, E.

1966 *In*, Skalinska, Pogon, et al., Further studies in chromosome numbers of Polish angiosperms. *Acta biol. Cracov.* (B) 9: 31-58.

POISON PLANTS COMMITTEE

1929 Report. *J. Coun. Sci. industr. Res. Aust.* 2: 47.

PRAGLOWSKI, J.

1969 Pollen types in species of *Haloragis*. *Svensk. bot. Tidskr.* 63: 486-490.

1970 The pollen morphology of the Haloragaceae with reference to taxonomy. *Grana* 10: 159-239.

PULLE, A. A.

1952 *Compendium van de Terminologie, Nomenclatuur en Systematiek der Zaadplanten.* 3rd ed. Utrecht.

RAIMANN, R.

1893 Hydrocaryaceae, in Engler, H. G. A. and K. A. E. Prantl, *Die naturlichen Pflanzenfamilien* III. Vol. 7. Leipzig.

RAM, M.

1956 Floral morphology and embryology of *Trapa bispinosa* Roxb. with a discussion on the systematic position of the genus. *Phytomorph.* 6: 312-323.

RAOUL, M. E.

1846 *Choix de plantes de la Nouvelle Zelande.* Paris.

RAVEN, P. H.

1962 Amphitropical relationships in the floras of North and South America. *Quart. Rev. Biol.* 38: 151-177.

RAYNAL, A.

1965 Les especies africaines du genre *Laurembergia* Berg. (Halorrhagaceae) et leur repartition. *Webbia* 19: 683-695.

1967 Les Halorrhagacees Malagaches et leur repartition. *Adansonia* (2) 6: 537-543.

REICHENBACH, H. G. L.

1828 *Conspectus regni vegetabilis* . . . Leipzig.

1832 *Flora Germanica excursoria* . . . Leipzig.

RENDLE, A. B.

1925 *The classification of flowering plants.* Vol. 2. Cambridge.

RICARDI, M., C. MARTICORENA, M. SILVA and F. TORRES

1958 Deteccion de saponinas en angiospermae Chilenas. *Bol. Soc. Biol. Concepcion.* 33: 29-94.

RICHARD, L. C. M.

1808 *Demonstrations botaniques,* . . . Paris.

RIDLEY, H. N.

1916 Report on the botany of the Wollaston expedition to Dutch New Guinea, 1912-1913. *Trans. Linn. Soc.* 9: 1-284.

1922 *Flora of the Malay peninsula.* Vol. 1. London.

RODRIGUEZ, R. L.

1971 The relationships of the Umbellales, *in*, Heyward, V. H. (ed.), *The biology and chemistry of the Umbelliferae*. London.

RODWAY, L.

1903 *The Tasmanian flora*. Hobart.

SALISBURY, R. A.

1796 *Prodromus stirpium in horto ad Chapel Allerton vigentium*. London.

SAMUELS, J. A.

1912 Etudes sur le developpement du sac embryonnaire et sur la fecondation chez le *Gunnera macrophylla*. *Arch. Zellforsch.* 8: 52-120.

SARKAR, A. K., N. DATTA and U. CHATTERJEE

1973 *in*, I.O.P.B. Chromosome number reports XLII. *Taxon* 22: 652-653.

SAUNDERS, E. R.

1939 *Floral morphology*. Vol. 2. Cambridge.

SAVIDGE, J. P.

1956 *Callitriche platycarpa* Kutz. *Proc. Bot. Soc. Brit. Isles* 2: 20.

SCHEERER, H.

1939 Chromosomenzahlen aus der Schleswig-Holsteinischen flora. 1. *Planta* 29: 636.

SCHINDLER, A. K.

1904 Die Abtrennung der Hippuridaceen von den Haloragaceen. *Bot. Jb.* 34, Beibl. 77: 1-77.

1905 Halorrhagaceae, *in*, Engler, H. G. A., *Das Pflanzenreich* 23: 1-133. Berlin.

1911 Halorrhagaceae novae. 1. *Fedde Repert.* 9: 123.

SCHLECHTENDAL, D. F. L. von

1847 Bestimmung und Beschreibung der vom Dr. Behr in Sudaustralien gesammelten Pflanzen. *Linnaea* 20: 559-672.

SCHNARF, K.

1931 *Vergleichende Embryologie der Angiospermen*. Berlin.

SCHNEGG, H.

1902 Beiträge zur Kenntnis der Gattung *Gunnera*. *Flora* 90: 161-208.

SCHOMBURGK, R.

1875 *The flora of South Australia*. Adelaide.

SCHOTT, H.

1827 Fasciculus plantarum Brasiliensium. *in*, Sprengel, C. *Systema vegetabilium* ed. 17, Appendix. Goettingen.

SCHREBER, J. C. D. (Editor)

1789 *Caroli a Linne . . . genera plantarum*. Vol. 1. 8th ed. Frankfurt.

SELLING, O.

1947 Studies in Hawaiian pollen statistics, part II. The pollen of the Hawaiian phanerogams. *Spec. Publ. Bishop Mus.* 38: 165-168.

SHAW, H. K. A. (Editor)

1966 J. C. Willis, *A dictionary of the flowering plants and ferns*. 7th ed. Cambridge.

SHIMOYAMA, S.

1958 Chromosome studies in Japanese *Callitriche*. *A. R. nat. Inst. Genet., Japan* 8: 50-51.

SIEBOLD, P. F. von and J. G. ZUCCARINI

1835 *Flora Japonica . . .* Leiden.

SINCLAIR, J.

1956 Additions to the flora of Singapore and new localities in Singapore for some plants thought to be extinct. — part II. *Gard. Bull. Singapore* 15: 22-30.

SINGH, D.

1954 Floral morphology and embryology of *Hedera nepalensis* K. Koch. *Agra Univ. J. Res. Sci.* 3: 289-299.

SKOTTSBERG, C.

1922 *Natural history of Juan Fernandez and Easter Island.* Uppsala.

SOKOLOVSKAJA, A. P.

1960 Geographical distribution of polyploid species of plants (investigation of the flora of Sakhalin island). *Vestn. Lening. Univ. Ser. Biol.* 4: 42-58.

SONDER, W.

1856 Plantae Muellerianae. Halorageae. *Linnaea* 28: 229-234.

SOUEGES, R.

1922 Recherches embryogeniques sur l'*Hippuris vulgaris. C.R. Acad. Sci., Paris* 175: 529-532.

1940 Embryogenie des Haloragacees. Developpement de l'embryon chez le *Myriophyllum alterniflorum. C.R. Acad. Sci., Paris* 211: 185-187.

1952 L'albumen et l'embryon chez le *Callitriche vernalis* Kuetz. (*C. verna* L.). *C.R. Acad. Sci., Paris* 235: 453-456.

SPACH, E.

1835 *Histoire naturelle des vegetaux. Phanerogames.* Vol. 4. Paris.

SPECHT, R. L. and C. P. MOUNTFORD

1958 *Records of the American-Australian scientific expedition to Arnhem Land. 3. Botany and plant ecology.* Carlton.

SPRENGEL, K. P. J.

1825 *Caroli Linnaei . . . systema vegetabilium.* Vol. 2. 16th ed. Goettingen.

1827 ibid. Vol. 4. *Curae posteriores, and Appendix.* Goettingen.

STAFLEU, F. A.

1966 New herbarium abbreviations. *Taxon* 15: 334-336.

1967 *Taxonomic literature.* Utrecht.

STAFLEU, F. A., et al. (Editor)

1972 *International code of botanical nomenclature.* Utrecht.

STEARN, W. T.

1952 Lindley's "Vegetation of the Swan River Colony". *J. Soc. Bibl. Nat. Hist.* 2: 381-382.

1966 *Botanical latin.* London and Edinburgh.

STEUDEL, E. T.

1840 *Nomenclator botanicus seu: synonymia plantarum universalis . . .* Stuttgart and Tubingen.

STOLT, K. A. H.

1928 Die embryologie von *Myriophyllum alterniflorum* DC. *Svensk. bot. Tidsk.* 22: 305-319.

TAKHTAJAN, A.

1969 *Flowering plants. Origin and dispersal.* Edinburgh.

TARDIEU-BLOT, M.-L.

1965 *Flore du Cambodge du Laos et du Vietnam.* Vol. 4. Paris.

TATE, R.

1880 A census of the indigenous flora of extra-tropical South Australia. *Trans. R. Soc. S. Aust.* 3: 46-90.

1882 Supplement to a census of the indigenous flowering plants and ferns of extra-tropical South Australia. *Trans. R. Soc. S. Aust.* 4: 106.

1883a List of plants unrecorded for southern Eyre Peninsula. *Trans. R. Soc. S. Aust.* 6: 94-95.

1883b The botany of Kangaroo Island. *Trans. R. Soc. S. Aust.* 6: 96-156.

1884 Additions to the flora of extra-tropical South Australia. *Trans. R. Soc. S. Aust.* 7: 72-73.

1888a Additions to the flora of the Port Lincoln district, including brief descriptions of two new species. *Trans. R. Soc. S. Aust.* 11: 82-84.

1888b Plants of the Lake Eyre basin. *Trans. R. Soc. S. Aust.* 11: 85-100.

1889a A revision of the flora of Kangaroo Island and other botanical notes relating thereto. *Trans. R. Soc. S. Aust.* 12: 62-66.

1889b A census of the indigenous flowering plants and vascular cryptogams of extra-tropical South Australia. *Trans. R. Soc. S. Aust.* 12: 67-128.

1890 *A handbook of the flora of extra-tropical South Australia.* Adelaide.

1896 Botany, *In*, Spencer, *Horn expedition to central Australia, Report, part 3 — geology and botany.* London.

TAYLOR, R. L. and G. A. MULLIGAN
1968 *Flora of the Queen Charlotte Islands. Part 2. Cytological aspects of the vascular plants.* Ottawa.

TEPPER, J. G. O.
1880a Native and naturalised plants, Ardrossan, Yorke Peninsula. *Trans. R. Soc. S. Aust.* 3: 34-45.
1880b Appendix to the list of plants about Ardrossan. *Trans. R. Soc. S. Aust.* 3: 176.
1887 Additions to the flora of Kangaroo Island. *Trans. R. Soc. S. Aust.* 9: 114-115.

THORNE, R. F.
1968 Synopsis of a putatively phylogenetic classification of the following plants. *Aliso* 6: 57-66.
1973 Inclusion of the Apiaceae (Umbelliferae) in the Araliaceae. *Notes R. bot. Gdn. Edinb.* 32: 161-165.

THUNBERG, C. P.
1783 *Nova genera plantarum, part 3.* Uppsala.
1784 *Flora Japonica . . .* Leipzig (Facsimile, Tokyo, 1933).

TIAGI, Y. D.
1969 Vascular anatomy of the flower of certain species of the Combretaceae. *Bot. Gaz.* 130: 150-157.

TISON, A.
1919 Sur le suspenseur du *Trapa natans. Rev. gen. Bot.* 31: 219-228.

TRELA-SAWICKA, Z.
1965 Cytological investigations in the genus *Trapa* L. *Acta biol. Cracov.* (B) 8: 237-243.

TROLL, W.
1964 *Die Infloreszenzen, Typologie und Stellung im Aufbau des Vegetationskörpers.* Bd. 1. Jena, Stuttgart.

TSENG, C. C.
1967 Anatomical studies of flower and fruit in the Hydrocotyloideae (Umbelliferae). *Univ. Calif. Publ. Bot.* 42: 1-79.

TUYAMA, T.
1940 On genus *Haloragis* and Micronesian species. *J. Jap. Bot.* 16: 273-285.

UNGER, D. F.
1849 Die Entwicklung des Embryos von *Hippuris vulgaris. Bot. Ztg.* 7: 329-339.

VALETON, T.
1907 Plantae Papuanae. *Bull. Dept. Agr. Ind. Neerl.* 10: 1-70.

VAN DER MEIJDEN, R.
1969 An annotated key to the south-east asiatic, Malesian, Mascarene, and African species of *Myriophyllum* (Haloragaceae). *Blumea* 17: 303-311.
1970 Haloragaceae. In *Flora of Thailand* 2: 1-4.

VAN DER MEIJDEN, R. and N. CASPERS
1971 Haloragaceae. *Flora Malesiana* 7: 239-263.

VAN STEENIS, C. G. G. J.
1934 On the origin of the Malaysian mountain flora. Part 1. *Bull. Jard. bot. Buitenz.* (III) 13: 135-262.
1962 The mountain flora of the Malaysian tropics. *Endeavour* 21: 183-193.

VENKATESWARLU, J. and P. S. PRAKASH RAO
1970 The floral anatomy of Combretaceae. *Proc. Indian Acad. Sci.* (B) 36: 1-20.

VENTENAT, E. P.
1799 *Tableau du regne vegetal, . . .* Paris.

VIRKKI, N.
1962 Meiosis and development of the embryo sac in *Gunnera insignis* (Oersted) DC. (Halorrhagaceae). *J. Agric. Univ. P.R.* 46: 254-268.

VOLKENS, G.
1902 Die Vegetation der Karolinen, mit besonderer Berücksichtigung der von Yap. *Bot. Jb.* 31: 412-477.

WADE, L. K. and D. N. MCVEAN
1969 Mt. Wilhelm studies I. The alpine and subalpine vegetation. *Publ. Research School of Pacific Studies, A.N.U.* B.G./1: 97-217.

WALPERS, W. G.

1843 *Repertorium botanices systematicae.* Vol. 2. Leipzig.

1846 ibid. Vol. 5. Leipzig.

1848 *Annales botanices systematicae.* Vol. 1. Leipzig.

1858 ibid. Vol. 4. Leipzig.

1870 ibid. Vol. 7. Leipzig.

WEBB, L. J.

1949 An Australian phytochemical survey. I. Alkaloids and cyanogenetic compounds in Queensland plants. *C.S.I.R.O. Bull.* 241: 1-56.

1952 An Australian phytochemical survey. II. Alkaloids in Queensland flowering plants. *C.S.I.R.O. Bull.* 268.

WEBERLING, F.

1965 Typology of inflorescences. *J. Linn. Soc. (Bot.)* 59: 215-221.

WENT, F. W.

1924 Halorrhagaceae. *Nova Guinea* 14: 105-109.

WETTSTEIN, R.

1935 *Handbuch der Systematischen Botanik.* 4th ed. Leipzig and Wien.

WHITE, C. T.

1942 Contributions to the Queensland flora. No. 7. *Proc. R. Soc. Queensland* 53: 201-228.

WIGHT, R. and G. A. W. ARNOTT

1834 *Prodromus florae peninsulae Indiae orientalis.* London.

WILKINSON, A. M.

1944 Floral anatomy of some species of *Cornus. Bull. Torrey bot. Cl.* 71: 276-301.

WILLDENOW, C. L. (Editor)

1797 *Caroli a Linne species plantarum . . .* Vol. 1. 4th ed. Berlin.

WILLIS, J. H.

1972 *A handbook to plants in Victoria.* Vol. 2. Carlton.

WINGE, D.

1917 The chromosomes. Their numbers and general importance. *C.R. Lab. Carlsberg* 13: 131-275.

WINNECKE, C.

1886 Plants collected in central Australia. Examined by Baron Ferd. von Mueller. *Trans. R. Soc. S. Aust.* 8: 10-13.

ZHUKOVA, P. G.

1966 Chromosome numbers in some species of plants of the north-eastern part of the U.S.S.R. *Bot. Zh.* 51: 1511-1516.

INDEX

In this index, orthographic variants such as *Halorrhagis* and *Goniocarpus*, and their various compounds, are listed as if spelt *Haloragis* and *Gonocarpus*. Species only mentioned incidentally under the heading "Ecology" are not indexed. Accepted names are in roman type, synonyms and misapplied names are in *italics*. The page numbers of the major reference(s) to the taxon are in *italics*.